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Archaeological heritage in forested areas – challenges, problems and solutions

Abstract

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The paper is meant as a springboard for a discussion on the issue of archaeological finds in forested areas, with regard to the situation in Poland. Firstly, the issue of identifying cultural heritage in forested areas will be discussed, with a particular emphasis on the role and significance of the latest non-invasive technologies, especially laser scanning (LiDAR). Another element of the paper is the issue of protecting cultural and environmental heritage, therefore, the issue requiring an interdisciplinary approach, the necessity to work out optimal solutions, at the same time recognising the two aforementioned groups of historic objects that require integrated activities, as well as large-scale and long-term strategies. Examples of current activity will be presented by referring to the work that is being / has been realised, using the experience gained from scientific projects or institutional activities in Poland. The paper is directed towards “preventive activities to save archaeological objects in forested areas” and answering the question – how to effectively and optimally identify, examine, protect, manage and present historic heritage in forested areas. The paper fits in with tasks related to “Inventorying cultural heritage”, which are carried out within the assignment commissioned by the State Treasury – the State Forests National Forest Holding - General Forest Management.

Keywords: forested areas, archaeology, State Forests, Poland

■ INTRODUCTION – ARCHAEOLOGICAL (HISTORIC) HERITAGE IN FORESTED AREAS IN POLAND – CHALLENGES, PROBLEMS AND SOLUTIONS

Archaeological objects in forested areas constitute a part of cultural heritage that, in recent years, has acquired an additional tool for their identification and documentation, namely laser scanning, and especially aerial laser scanning (ALS – LiDAR) (in Poland since 2008 e.g.: Nowakowski 2010; Sławik, Zapłata 2010; Budziszewski, Zapłata 2011; Banaszek, Rączkowski 2010; Kobyliński *et al.* 2012; Zapłata 2013; Czebreszuk *et al.* 2013; Zapłata *et al.* 2014; Banaszek 2014; Bakuła *et al.* 2016). As numerous results of recent research suggest, in forested areas e.g. in Poland historic resources are very tentatively identified and, at the same time, poorly protected by e.g. an inscription in the monument register (in relation to ALS data in Poland among others: Budziszewski,



Fig. 1. Logotype of inventory tasks carried out within the projects discussed in the text (Prep. by S. Wajda)

Grabowski 2015; Zapłata *et al.* 2015; Byszewska 2018). The situation has been noticed by both milieus associated with heritage protection, and the management of forested areas, including the State Forests National Forest Holding (Decyzja nr 343). Therefore, the challenge that has recently emerged is the common and optimal (1) use of new technologies, and sets of data, to detect and inventory cultural resources, as well as (2) including identification results into the statutory activities of the above mentioned institutions, in order to avoid e.g. clashes and destruction of historic (archaeological) heritage (Zapłata, Stereńczak 2018).

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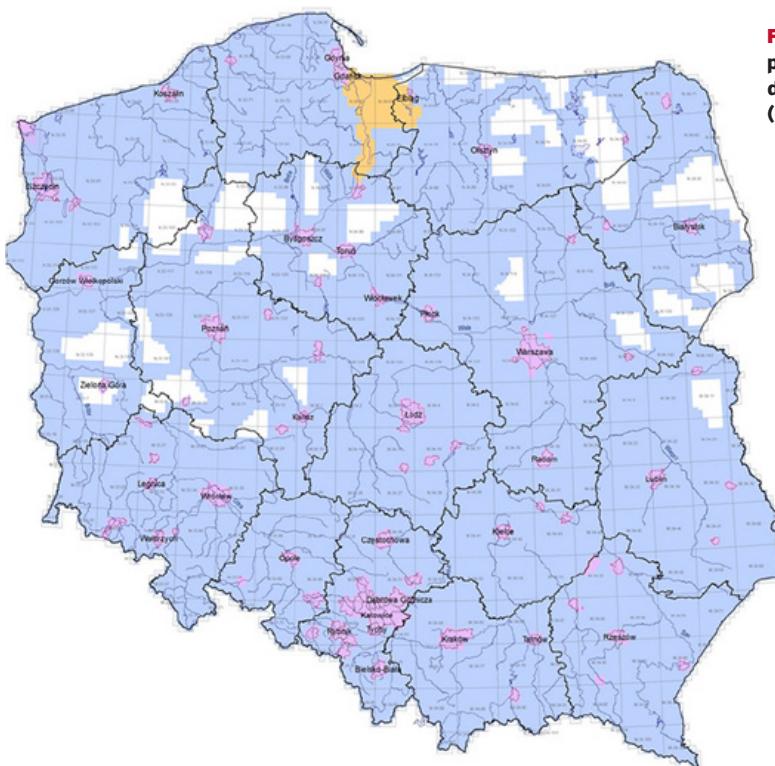


Fig. 2. Scope of photogrammetric products – point cloud from the ISOK project. Source of data: <http://www.gugik.gov.pl/projekty/isok> (access: 30.06.2018)

The creation of a data base within the ISOK project, which covers almost 100% of Poland, and therefore practically the entire forested area in the country, is a definite advantage (Kurczyński 2012; Węzyk 2015). The above mentioned technological potential became appreciated during the research of forested areas e.g. within numerous research initiatives, conservation activities or interdisciplinary undertakings, which designated new forms of activity concerning identification of archaeological heritage in Poland.

Among such activities are e.g. tasks such as “Inventorying cultural heritage”, which are carried out within the assignment commissioned by the State Treasury – the State Forests National Forest Holding - General Forest Management. The aforementioned initiatives, realised since 2016, constitute yet another example of the research on cultural resources in forested areas in Poland, as well as the first example, in the history of Polish archaeology, of the area manager initiating and supporting the protection of historic heritage in the form of interdisciplinary, system research (Decyzja nr 343; Decyzja nr 534; Decyzja nr 131; Wysocki 2017; Zapłata, Stereńczak 2018).

The initiative fills in the gap in identifying historic objects which, so far (e.g. for the lack of the discussed methods), have not been identified in the course of other research, including national programmes, and is also a step towards environmental and social expectations on the part of the area manager who is keenly interested in the history of the area, protection of cultural heritage,

and modernisation of economic strategies in forested areas. The starting impulse for interdisciplinary activities involving e.g. specialists in archaeology, forestry, history of geoinformation / geomatics, geodesy and remote sensing, geophysical research, archaeobotany, soil science etc., was (1) poor state of identification of archaeological resources in the forested areas in Poland (e.g. in the areas of commercial forestry), particularly considering non-invasive methods, including remote sensing resources –ALS (ISOK) data; as well as (2) the need to identify cultural resources for e.g. the area manager – the State Forests.

■ IDENTIFICATION OF CULTURAL (ARCHAEOLOGICAL) HERITAGE IN FORESTED AREAS ON THE BASIS OF DATA AND NON-INVASIVE TECHNOLOGIES

Among fundamental tools employed for identifying and inventorying historic objects one has to include aerial laser scanning, and the data base of measurements carried out in Poland – the ISOK base. Besides the above mentioned database, the application of archival cartographic materials for the identification of historic objects in forested areas has become increasingly popular, particularly in reference to historic objects such as old rural buildings, post-industrial objects etc. (Zawadzki 2017; Zawadzki *et al.* 2018).

Another database contributing to non-invasive prospecting of archaeological monuments, which is of

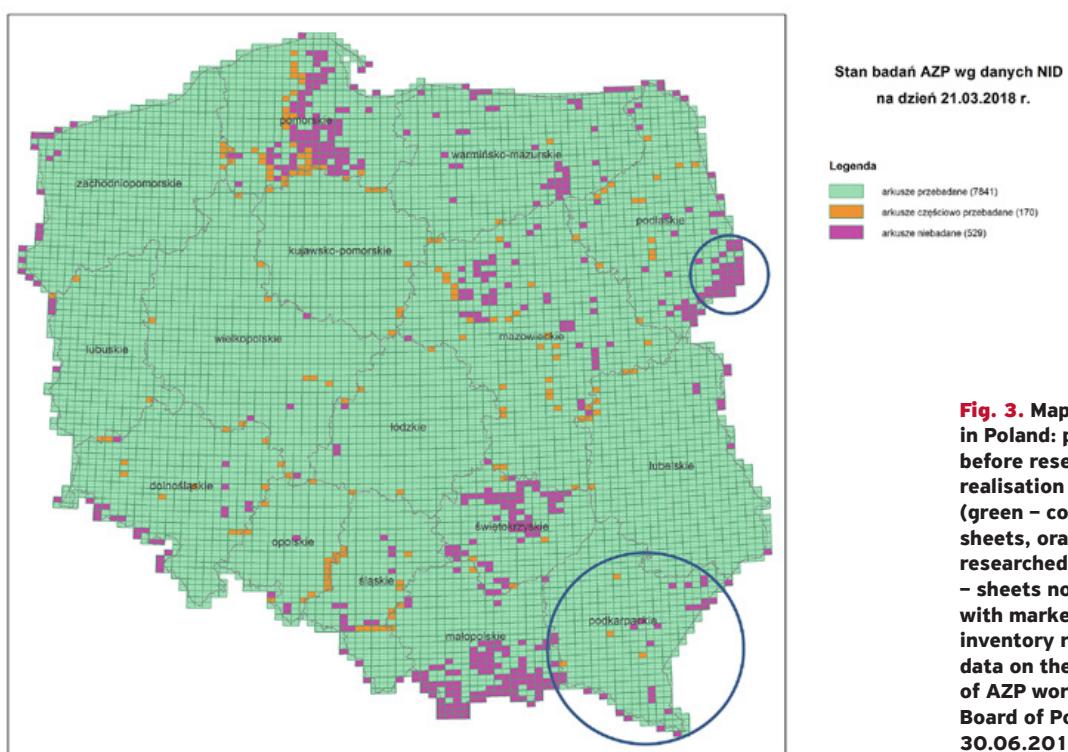


Fig. 3. Map with AZP areas in Poland: pink colour – areas before research. State of realisation of AZP programme (green – completely researched sheets, orange – partially researched sheets; purple – sheets not examined) with marked areas of SFGM inventory research. Source of data on the state of realisation of AZP work: National Heritage Board of Poland (access: 30.06.2018)

growing interest to archaeological circles, are archive aerial photographs. Naturally, surface and geophysical research or mobile – field photogrammetric systems also belong to the group of non-invasive methods (Zapłata, Różycki 2015; Różycki, Zapłata 2017; Zawadzki *et al.* 2018).

The potential of ALS data, ISOK data, and their processing, already appreciated by scientific-research and conservation milieus, acquires new aspects every year, for instance in the form of new photogrammetric input, new, more precise data (than ISOK data, with better coverage of the designated area etc.) obtained from unmanned flying units, or finally flights dedicated to archaeological research.

In comparison to previous research of forested areas, archaeology employing LiDAR technology allows for identifying tens or even hundreds more historic resources. Such a situation also poses a question about protection of resources in such a specific environment as a forest.

■ PROTECTION OF CULTURAL AND ENVIRONMENTAL HERITAGE – INTEGRATED, SYSTEMATIC, WIDE-RANGE, INTERDISCIPLINARY AND LONG-TERM STRATEGIES

Cultural resources in forested areas are worth considering from yet another perspective, because of the

Fig. 4. An example of today non existing Czeremcha village (on the left, satellite images [2017] on the right, a fragment of the Kataster Galicyjski [1851]). Ed. M. Zawadzki. Source of data: GUGiK and Archiwum Państwowe in Przemyśl.



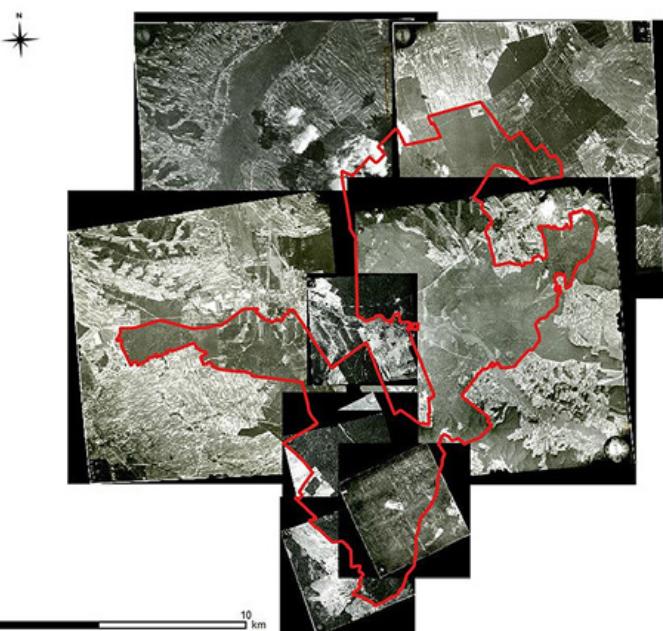


Fig. 5. Example of archive aerial photographs covering the area of the Roztocze National Park. Source of data: NARA (Prep. by S. Różycki)

specificity of the environment in which they are located. They are worth looking at from the perspective of interdisciplinary, seemingly doubled protection – the combined protection of cultural heritage and environment. That is the purpose served by e.g. created and constantly modified concepts and their practically applied assumptions among which are integrated, systematic, wide-range, interdisciplinary and long-term strategies. Such

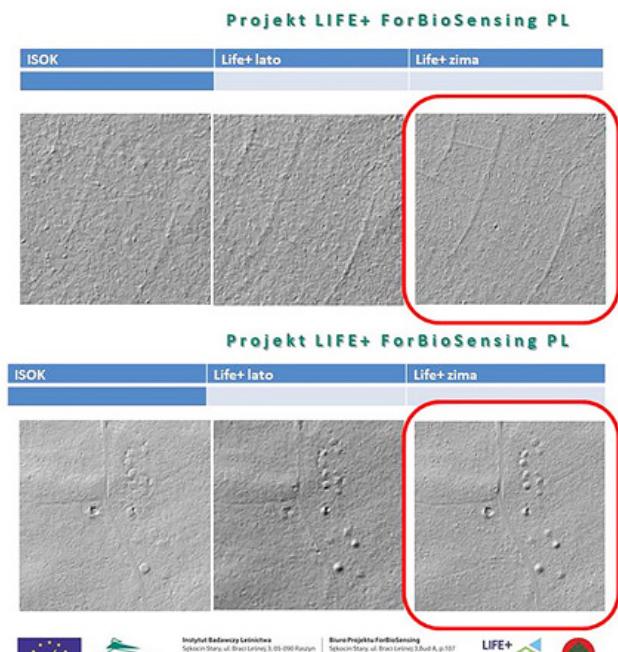


Fig. 6. Comparison of sample ALS data conversions with recognised archaeological objects (hillshade): ISOK and project Life+ (summer) and life+ (winter) (Prep. by IBL)

approaches focus attention not only on cultural heritage but also environmental, thus introducing much data and information from the managers of the areas that are subjected to diverse economic activities.

Protection of cultural resources can be an opportunity for a better protection of the natural resources; at the same time, protection of natural resources is a form of protection of cultural resources, which can be observed in relation to many situations in Poland and the world. Therefore, the most complete identification of both types of cultural resources constitutes the basis for creating an optimal system of identifying, protecting and managing cultural and environmental heritage. Hence, it seems vital to ensure cooperation between the milieus of foresters and archaeologists or conservators, and to plan together strategies for the future.

In recent years, the discussed concept found its practical manifestation e.g. in the form of initiatives of the General Forest Management, such as “Evaluation and monitoring of changes in the state of biodiversity in the Białowieża Forest on the basis of selected natural and cultural elements” (polish title „Ocena i monitoring zmian stanu różnorodności biologicznej w Puszczy Białowieskiej na podstawie wybranych elementów przyrodniczych i kulturowych”), “Evaluation (...) – continuation” (polish title “Ocena (...) – kontynuacja”) or „Evaluation of the state of biodiversity in selected Forestry Commissions of RFM Krosno on the basis of selected natural and cultural elements” (polish title „Ocena stanu różnorodności biologicznej w wybranych nadleśnictwach RDLP Krosno na podstawie wybranych elementów przyrodniczych i kulturowych”) and “Evaluation (...) – continuation” (polish title “Ocena (...) – kontynuacja”), within the task “Inventorying cultural heritage” (polish title “Inwentaryzacja dziedzictwa kulturowego”) the executors of which are consortia whose leader is the Forestry Research Institute, and partners e.g. in 2016 was the Archaeology and Ethnology Institute PAN, and since 2017 the Hereditas Foundation, with numerous partners and contractors.

The main aim of the work is primarily (1) identifying cultural resources in the State Forests area, (2) using ALS data to identify known historic objects, with additional recognition of their context, (3) correlation of cultural resources with objects of nature, (4) inventory of recognised resources, and (5) including the data concerning resources into the geo-base of the area manager, in order to include it in further statutory activities and economic strategies. The major goal is presenting the past and the history of forested areas and popularising that knowledge, which shapes the awareness about the



Fig. 7. Examples of forest management activity – preparing the soil (Photo by S. Bochyński)

enormous resources that require the specific treatment and efficient use of innovative research methods, both in the society, among foresters and people involved in monument protection.

**TYPES AND KINDS OF FOREST ENVIRONMENTS AND IDENTIFICATION / PROTECTION / MANAGEMENT AND EXHIBITING CULTURAL HERITAGE:
UTILITY FORESTS – RESERVES – NATIONAL PARKS**

Optimal identification and protection, as well as managing and including historic objects in statutory activities of forest areas managers require working out an appropriate strategy that would take into account the diversity of forested areas. In Poland we distinguish several groups: (1) areas under complete (strict etc.) protection like National Parks, (2) reserves under (passive and/or active) protection, and (3) utility forests – specific areas covering the largest part of the country, which are subjected to e.g. various treatment related to preparing soil or acquiring the natural raw material – wood (Zarządzenie nr 53; Haze 2012). In relation to the former groups, the situation seems to be fairly favourable for historic – archaeological objects, where threats posed by contemporary human activity are insignificant, and only natural processes (e.g. blowdowns, fallen trees etc.) can result in damage or destruction.

The last group are areas characterised by dynamic, systematic though often small-scale activity occurring at a specified frequency. In the majority of those areas the ground remained undisturbed by human activity for tens of years. But the areas requiring intensive protection – preventive activity are e.g. utility forests undergoing

current treatment and economic activities (see e.g. Affek *et al.* 2017). And drawing particular attention to them constitutes the fundamental element of the conducted activities and shared, interdisciplinary, scientific-research and management strategies planned for the future.

**■ PREVENTIVE MECHANISMS AGAINST DESTROYING HISTORIC OBJECTS
- ANTHROPOGENIC AND NATURAL THREATS**

Prevention, i.e. stopping the threats, dangers and destruction (often unaware) of historic objects is somehow inscribed in the presented inventorying initiatives. In order to prevent the above mentioned processes the initial and fundamental principle was accepted - firstly – to

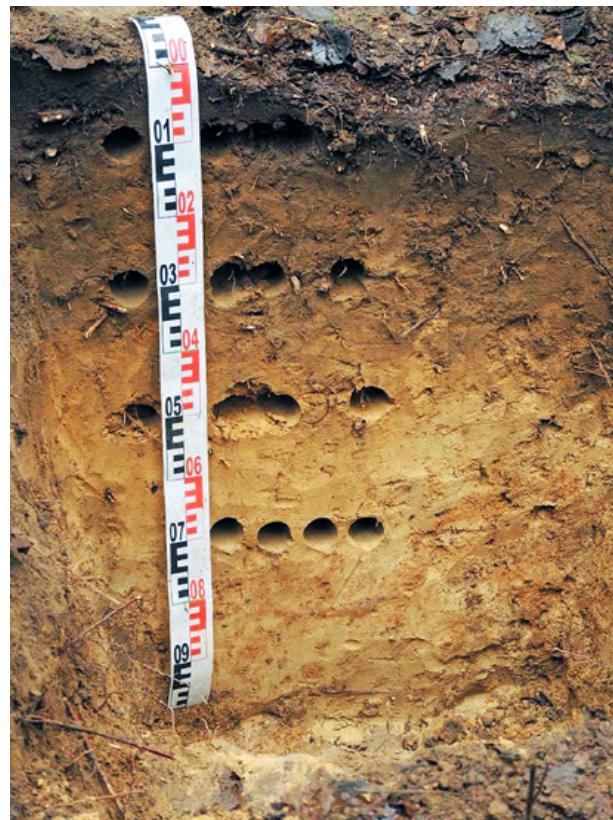
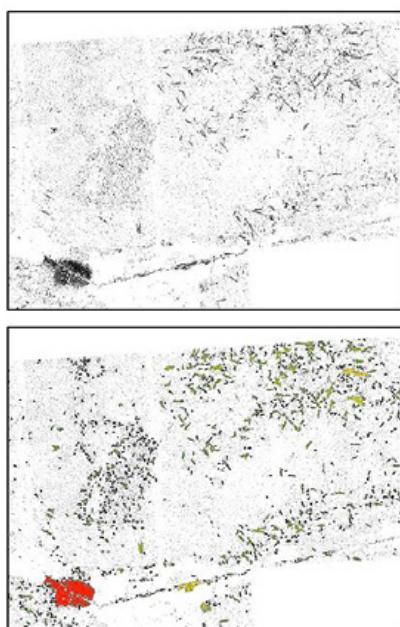


Fig. 8. Instances of soil surveys and collected samples on old settlement sites – Białowieża Forest (Photo by M. Ksepko)



Raster prezentujący wycinek chmury punktów z widocznymi powalonejmi drzewami.



Warstwa SHP mogąca pomóc wskazać miejsca gdzie znajdują się powalone drzewa.

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Fig. 9. Sample visualisation of ALS data indicating blown-down trees (Prep. by IBL., Photo by R. Zapłata)

identify historic resources. The ALS data base was used for this purpose, including ISOK base, as well as other data making it possible to indicate (potential) historic objects, earmarking the recognised resources – objects for a multi-level verification on site during the next stages of work. Surface prospecting became the fundamental method initiating fieldwork. Further work was based on geophysical research and boreholes – surveying the ground with a soil probe and/or geological drill. The work was complemented by survey research of selected archaeological objects. For instance, soil science

or phytosociological research, aimed at determining the correlation between cultural and environmental benefits, was added to the work integrated with the above mentioned archaeological activities. Particular attention was focused on areas associated with economic activity, in order to verify the occurrence of historic objects, determine their range etc. Afterwards, such information is to be used to shape the economic policy of the area manager, allowing for considering the resources in e.g. the created plans of forest development (Święcicki 2012a; Święcicki 2012b; Święcicki 2012c).

Another issue involved activities relating to identifying historic resources and determining damage and threats resulting from natural processes. Among such examples were e.g. (1) an analysis of occurrence of fallen trees – blowdowns, where there is the danger of destroying the revealed cultural layers, movable artefacts or human bone relics; as well as (2) an analysis of sites where such phenomena might occur (e.g. detecting sick trees implying danger for historic objects in the coming years – e.g. on the basis of the project “Life ...” Forestry Research Institute).

■ EXAMPLES OF INTERDISCIPLINARY ACTIVITIES: BIAŁOWIEŻA FOREST – RSFM IN KROSTNO

Examples of the presented activities and implemented concepts are the above mentioned projects realized in forested areas in Poland since 2016, e.g. in the Polish section of the Białowieża Forest (including the Białowieża National Park) or in the forested areas under the Regional State Forest Management in Krosno – in the south – east part of Poland.

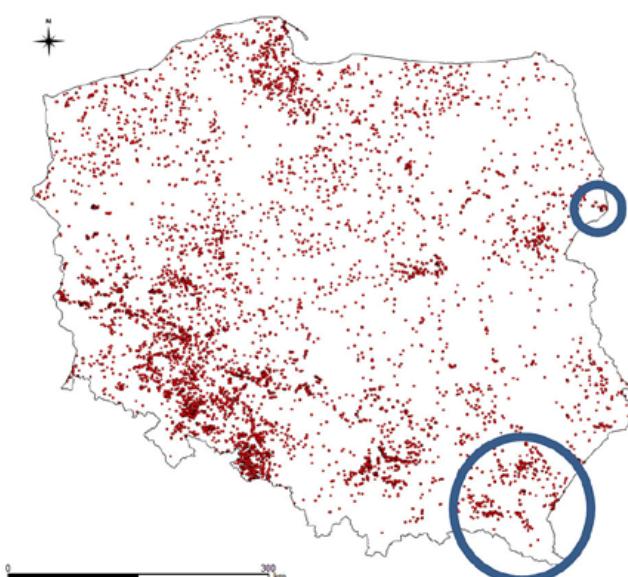


Fig. 10. Reconnaissance map illustrating locations of archaeological monuments entered in the register in Poland, with approximately marked areas of previous inventory work, where we encounter little identification or few register entries of historic objects. Oval marks approximate area of previous inventories. Source of data: <https://mapy.zabytek.gov.pl/nid/> (access: 31.12.2017)



Fig. 11. Logotype of the research for the task “Inventorying cultural heritage” – project “Evaluation and monitoring of changes in the biodiversity in the Białowieża Forest on the basis of selected natural and cultural elements – continuation” (Prep. by S. Wajda)



BIAŁOWIEŻA FOREST

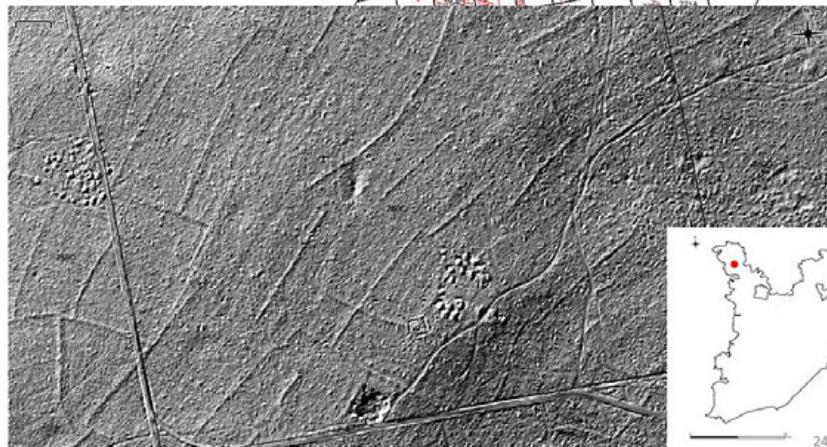


Fig. 12. Sample visualisation of recognised relics of former agricultural systems in the Białowieża Forest (Prep. by IBL)

Within the first initiative connected with the task “Inventorying cultural heritage” (archaeological) in the Białowieża Forest, over 20 thousand potential individual historic objects – potential anthropogenic objects were identified during the first stage of the work, part of which were positively verified on site (the work is still continued) (Stereńczak *et al.* 2017).

Among particularly interesting archaeological objects clusters of relics of former settlement – agricultural systems, recognised thanks to e.g. identification of characteristic elevations (small humps) occurring in lines in specific places, in clusters, constituting relics of old baulks, perhaps pathways between fields or edges of farmland used for growing crops or other purposes.



BIAŁOWIEŻA FOREST



Fig. 13. Photo of revealed arrangement of erratic stones, serving as an example of relics of historic baulks in the Białowieża Forest (Photo by K. Machnio, Prep. by IBL)



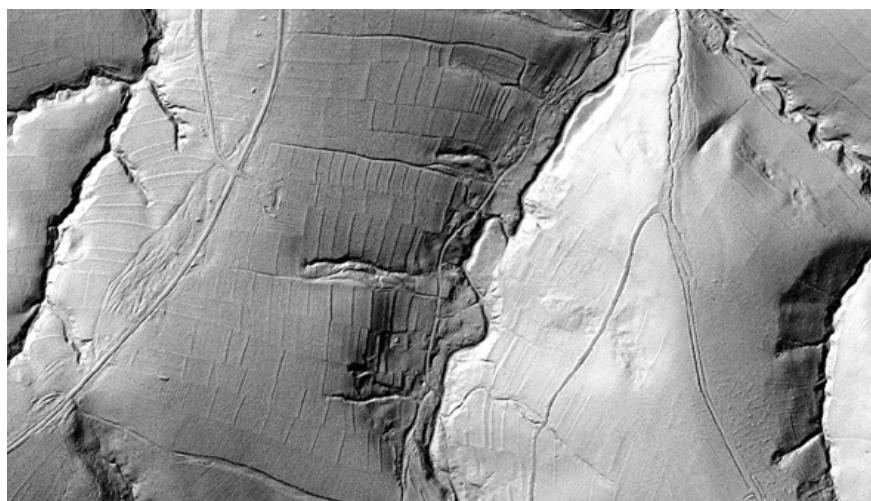


Fig. 14. Sample visualisation of ISOK-ALS data and vector marking of recognised objects with their own landscape form. Area of the SFRM in Krosno (Prep. by IBL)

Some identified objects are located in protected areas – in the Białowieża National Park or in natural reserves of the Białowieża Forest. Other have been very well preserved in utility forests, which urged scientists carrying out the research and the area manager to take further steps in order to protect and safeguard the objects, and to make them available to the general public *in situ* (Zaplata and Stereńczak 2016; Stereńczak *et al.* 2016; Zapłata *et al.* 2018 – about relics of former settlement – agricultural systems in Białowieża Forest other scientific research / papers e.g.: Zimny *et al.* 2017; Latalowa 2018).

The next example is the research-inventory work that has been carried out since 2016 in south-eastern Poland, especially in the area under the Regional Forest Management in Krosno, within the assignment “Inventorying cultural heritage”. Here, identification and inventorying of the relics of old – historic settlement, numerous field fortifications and historic elements associated with military conflicts, post-industrial and processing buildings, as well as prehistoric structures (barrows, sites where natural resources were mined or hillforts) is worth emphasising. Like in the case of the Białowieża Forest, thanks to identification numerous large-area sites (e.g. former Polish, Lemkos villages etc.) that were abandoned though their origins often dated back to the medieval period, were added to the map of contemporary protection of archaeological monuments in Poland (Zapłata, Stereńczak 2018).

The above examples justify the undertaken initiatives which result in identifying and inscribing numerous archaeological objects into the monument protection system, as well as recording them in the management system of those forested areas – the area manager’s system, with all known archaeological sites (objects). Such

a situation – together with commenced in-field verification – allowed for introducing a new perception of forested areas in Poland in the State Forests domain – the coexistence of cultural and environmental heritage, where economic activities take into consideration previously unknown, unidentified cultural resources requiring particular attention, innovative technologies and unprecedented protection.

The above mentioned projects are also examples of interdisciplinary efforts that result in identifying both cultural and natural resources, where the interrelation of their existence is visible in places, where the anthropogenically shaped past fits or can fit into the present state of biodiversity of forested areas in Poland.

Large-scale research of archaeological heritage constitutes the first such initiative in Poland – both in the history of archaeological research and the history of activity of the General Forest Management – directed towards identification of historic resources. The realised work is primarily characterised by initial identification of archaeological monuments, emphasising the non-invasive verification of recognised anthropogenic objects using the basic methods of field prospection.

■ SUMMARY, CONCLUSIONS AND RESEARCH DEMANDS

How to effectively and optimally identify, research, protect, manage and present historic resources in forested areas?

Summarising, it should be stated that current results of identifying historic resources in forested areas in Poland clearly confirm the legitimacy of undertaken initiatives which allowed for examining and inventorying numerous, previously unknown, historic objects; especially those objects which, despite years-long, intensive and extensive forest exploitation of the State Forests, have survived in many places with their own

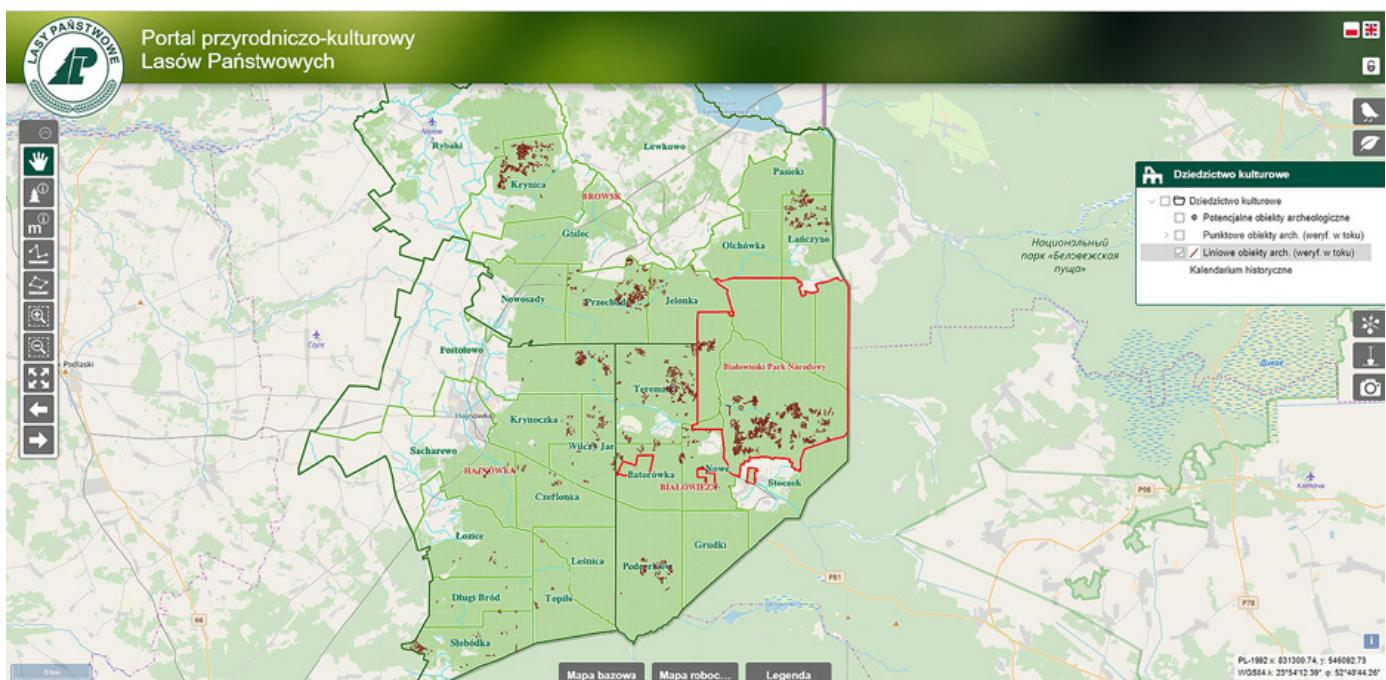


Fig. 15. State Forests natural-cultural portal – portal with information about archaeological resources in the Białowieża Forest. Source: <https://puszcza-bialowieska.lasy.gov.pl/> (access: 01.08.2018)

visible form of landscape. The visible *protective function of forests*, in juxtaposition with agricultural areas etc., confirms the uniqueness of the title areas and encourages building strategies that would allow for preserving cultural heritage while successfully managing forest economy.

Within research demands one ought to mention e.g. (1) the need to form integrated activities in involving the participation of representatives of scientific-conservation circles, associated with heritage protection, as well as representatives of area management, forest sciences etc., (2) involving further remote sensing resources in the research, also archive ones, and creating spatial data bases constituting an element of contemporary conservation policy, and of activity in forested areas, (3) considering e.g. large-scale sites, a look at cultural resources from the landscape perspective, also noticing the need for integrated activities to protect cultural and natural resources, (4) directing activities to crucial areas associated e.g. with current and planned economic activities in the forest, which would help to better and more efficiently protect historic resources, (5) further popularisation of the knowledge about cultural resources among naturalists or foresters, and the knowledge about natural resources among people connected to monument protection, in order to work out shared strategies for future actions, instead of separate, independently functioning systems.

In answer to the question – “how to effectively and optimally identify, research, protect, manage and present historic resources in forested areas?” – besides the above mentioned suggestions, it is worth adding that (1) the essential element of all activities aimed at protecting, managing, making available the information about those resources and integrating them in current economic activities within forested areas, is primarily identifying archaeological resources using non-invasive methods and available data, in a large-scale and systematic way, (2) and also the fact that inter-milieu – interdisciplinary activities (naturalists / foresters ... archaeologists, conservators, historians ...) – are indispensable elements in the research of cultural resources in forested areas, as they guarantee optimal efforts for protecting cultural and environmental heritage, not only at the stage of research realisation, but primarily at the research planning stage – planning strategies for protecting historic resources.

The discussed initiatives are being realised – they are continued and current research results are disseminated e.g. in the form of conference papers, media announcements or scientific publications. It is worth emphasising, that the described undertakings have already immensely contributed to learning about the analysed areas, considerably broadening the knowledge about the scale and intensity of human activity in those areas in the past.

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Translation Violetta Marzec

Bibliografia

- Affek A. N., Zachwatowicz M., Sosnowska A., Gerlée A., Kiszka K. 2017. Impacts of modern mechanised skidding on the natural and cultural heritage of the Polish Carpathian Mountains. *Forest Ecology and Management* 405, 391-403.
- Bakuła K., Ostrowski W., Zapłata R., Kurczyński Z., Kraszewski B., Stereńczak K. 2016. *Zalecenia w zakresie pozyskiwania, przetwarzania, analizy i zastosowania danych LIDAR w celu rozpoznania zasobów dziedzictwa archeologicznego w ramach programu AZP*. Warszawa: Narodowy Instytut Dziedzictwa, https://www.nid.pl/pl/Dla_specjalistow/Badania_i_dokumentacja/zabytki-archeologiczne/instrukcje-wytyczne-zalecenia/2017_instrukcja_LIDAR_NID.PDF (access: 31.08.2018)
- Banaszek Ł. 2015. *Przeszłe krajobrazy w chmurze punktów*. Poznań: Wydawnictwo Naukowe UAM.
- Banaszek Ł., Rączkowski W. 2010. Archeologia w lesie. O identyfikacji stanowisk archeologicznych w gminie Polanów (i nie tylko). In W. Rączkowski, J. Sikora (eds.), *Historia i kultura Ziemi Śląskiej 10: Miasto i gmina Polanów*. Polanów: Fundacja Dziedzictwo, Wydawnictwo Region, 117–131.
- Budziszewski J., Grabowski M. 2015. Zasoby archeologiczne na terenach polskich lasów. In D. J. Gwiazdowicz, K. Rykowski (eds.), *Materiały trzeciego panelu ekspertów w ramach prac nad Narodowym Programem Leśnym. Dziedzictwo. Lasy i gospodarka leśna w kulturze i dziedzictwie narodowym*. Sękocin Stary: Instytut Badawczy Leśnictwa, 207–218.
- Budziszewski J., Zapłata R. 2011, *Raport końcowy z wykonania zadania w ramach Programu „Dziedzictwo Kulturowe” priorytet 5 Ochrona zabytków archeologicznych ze środków Ministra Kultury i Dziedzictwa Narodowego. Zadanie pn. Badania pradziejowych kopalni krzemienia z użyciem LIDAR zostało wykonane w okresie od 01.01.2011 r. do 31.12.2011 r. zgodnie z umową nr 01163/11/FPK/NID, zawartą w dniu 13.05.2011 r., pomiędzy Ministrem Kultury i Dziedzictwa Narodowego a Uniwersytetem Kardynała Stefana Wyszyńskiego*, (typescript in the archive UKSW and NID). Warszawa.
- Byszewska A. 2018. *The archaeological heritage of Woodlands – collective responsibility*. (paper at the conference “Archeologia obszarów leśnych / The Archaeology of Woodlands”, 19-20.04.2018, Białowieża / Poland).
- Czebreszuk J., Jaeger M., Pospieszny Ł., Cwaliński M., Niebieszczański J., Strózik M. 2013. Modelowe badania nie-inwazyjnych obszarów leśnych – Las Krotszyn. Z badań nad przemianami krajobrazu kulturowego w pradziejach Wielkopolski. *Fontes Archaeologici Posnanienses* 49, 157-175.
- Decyzja nr 343. Decyzja nr 343 Dyrektora Generalnego Lasów Państwowych z dnia 16 czerwca 2016 r. w sprawie zlecenia konsorcjum czterech instytucji: Instytutu Badawczego Leśnictwa, Studia Opracowań Przyrodniczych Krzysztof Kajzer, Stowarzyszenia Ochrony Sów, Instytutu Archeologii i Etnologii Polskiej Akademii Nauk, usługi badawczej pod nazwą „Ocena stanu różnorodności biologicznej w Puszczy Białowieskiej na podstawie wybranych elementów przyrodniczych i kulturowych (OR.5001.25.3.2016).
- Decyzja nr 533. Decyzja nr 533 Dyrektora Generalnego Lasów Państwowych z dnia 4 listopada 2016 r. w sprawie zlecenia konsorcjum czterech instytucji: Instytutu Badawczego Leśnictwa, Instytutu Ochrony Przyrody Polskiej Akademii Nauk, F.H.U. BIODATA Michał Kocik, Fundacji HEREDITAS, usługi badawczej pod nazwą „Ocena stanu różnorodności biologicznej w wybranych nadleśnictwach RDLP Krosno na podstawie wybranych elementów przyrodniczych i kulturowych (OR.5001.30.3.2016).
- Decyzja nr 131. Decyzja nr 131 Dyrektora Generalnego Lasów Państwowych z dnia 1 czerwca 2017 r. w sprawie zlecenia konsorcjum czterech instytucji: Instytutu Badawczego Leśnictwa, Studia Opracowań Przyrodniczych Krzysztof Kajzer, Stowarzyszenia Ochrony Sów, Fundacji Hereditas, usługi badawczej pod nazwą „Ocena i monitoring zmian stanu różnorodności biologicznej w Puszczy Białowieskiej na podstawie wybranych elementów przyrodniczych i kulturowych – kontynuacja (OR.5001.2.3.2017).
- Haze M. (ed.) 2012. *Zasady hodowli lasu*. Warszawa: Dyrekcja Generalna Lasów Państwowych.
- Kobyliński Z., Borowski M., Budziszewski J., Herbrich T., Jasiewska A., Kobyliński Ł., Sławik Ł., Wach D., Wysocki J. 2012. Kompleksowe, niedestrukcyjne rozpoznanie zasobów archeologicznych Starego Kraju w województwie lubuskim. *Archeologia Środkowego Nadodrza* 9, 7-38.
- Kurczyński Z. 2012. Mapy zagrożenia powodziowego i mapy ryzyka powodziowego a dyrektywa powodziowa. *Archiwum Fotogrametrii, Kartografii i Teledetekcji* 23, 209-217. http://ptfit.sgp.geodezja.org.pl/wydawnictwa/archiwum_voll_23/Kurczynski.pdf (access: 31.08.2018).
- Latalowa M. 2018. *Osady śródleśnych jezior i torfowisk – źródło informacji o dawnej działalności człowieka w warunkach ograniczonej eksploracji archeologicznej*. [Sediments from mid-forest lakes and mires – a source of information on past human activity in the context of limited archaeological exploration]. (paper at the conference “Archeologia obszarów leśnych / The Archaeology of Woodlands”, 19-20.04.2018, Białowieża / Poland].
- Nowakowski J. 2010. *Airborne Laser Scanning (ALS) w polskiej archeologii. Próby, doświadczenia, wyniki* (paper at the conference “XIX Konferencja Sprawozdawcza. Badania archeologiczne na Nizinie Wielkopolsko-Kujawskiej w latach 2008-2009”. Poznań).
- Różyczycki S., Zapłata R. 2017. *Archiwalne zdjęcia lotnicze – potencjał i możliwości w badaniach dziedzictwa kulturowego na wybranych obszarach RDLP w Krośnie oraz na terenach Magurskiego i Roztoczańskiego Parku Narodowego*. (paper at the conference „Inwentaryzacja dziedzictwa kulturowego (archeologicznego) na wybranych obszarach RDLP w Krośnie oraz na terenie Magurskiego i Roztoczańskiego Parku Narodowego 2016-2017”, 30.11.2017, Krosno).

- Stereńczak K., Zapłata R., Wójcik J. 2017. „Inwentaryzacja dziedzictwa kulturowego” w polskiej części Puszczy Białowieskiej w 2016 r. w ramach usługi naukowo-badawczej pt. „Ocena stanu różnorodności biologicznej w Puszczy Białowieskiej na podstawie wybranych elementów przyrodniczych i kulturowych”. Warszawa-Sękocin Stary: Instytut Badawczy Leśnictwa. <https://www.ibles.pl/web/guest/badania/puszczabialowieska-dziedzictwo-kulturowe/inwentaryzacja-dziedzictwa-kulturowego> (access: 31.08.2018).
- Święcicki Z. 2012a. Instrukcja urządzania lasu. Część 1. Instrukcja sporządzania projektu planu urządzania lasu dla nadleśnictwa. Warszawa: Dyrekcja Generalna Lasów Państwowych.
- Święcicki Z. 2012b. Instrukcja urządzania lasu. Część 2. Instrukcja wyróżniania i kartowania w Lasach Państwowych typów siedliskowych lasu oraz zbiorowisk roślinnych. Warszawa: Dyrekcja Generalna Lasów Państwowych.
- Święcicki Z. 2012c. Instrukcja urządzania lasu. Część 3. Instrukcja techniczna sporządzania i wydruku map leśnych. Warszawa: Dyrekcja Generalna Lasów Państwowych.
- Wężyk P. (ed.), 2015. Podręcznik dla uczestników szkoleń z wykorzystaniem produktów LiDAR. Warszawa: Główny Urząd Geodezji i Kartografii. http://www.gugik.gov.pl/_data/assets/pdf_file/0019/23752/PODRECZNIK_ISOK_wyd.2.pdf (access: 31.08.2018).
- Wysocki J (ed.) 2017. Dziedzictwo kulturowe w lasach. Konserwacja zapobiegawcza środowiska 4. Archaeologica Hereditas. Warszawa: Wydawnictwo Fundacji Archeologicznej.
- Zapłata R., Sławik Ł., 2010, LIDAR zmienia archeologię. Geodeta 10/185, 42-44.
- Zapłata R. 2013. Nieinwazyjne metody w badaniu i dokumentacji dziedzictwa kulturowego – aspekty skanowania laserowego w badaniach archeologicznych i architektonicznych. Warszawa: Fundacja Hereditas.
- Zapłata R., Bałazy R., Lewicki J., Zawiła-Niedźwiecki T. 2015. Dziedzictwo kulturowe w lasach. Zabytki architektury, przemysłu, historyczne fortyfikacje i zasoby archeologiczne. Trudne wyzwania i interdyscyplinarne strategie ochrony. In: D. J. Gwiazdowicz, K. Rykowski (eds.), Materiały trzeciego panelu ekspertów w ramach prac nad Narodowym Programem Leśnym. Dziedzictwo. Lasy i gospodarka leśna w kulturze i dziedzictwie narodowym. Sekocin Stary: Instytut Badawczy Leśnictwa, 340-353.
- Zapłata R., Różycki S., 2015, Historic aerial photographs in the analysis of cultural landscape. In: T. Veljanovski, D. Cowley, I. Bugarski, V. Ivanisevic, G. Kiarszys (eds.), *Recovering lost landscapes* (= Institute of Archaeology Belgrade Monographs 58, Aerial Archaeology Research Group. Occasional Publication 6). Belgrade: Institute of Archaeology, 107-115.
- Zapłata R., Stereńczak K. 2016. Puszczka Białowieska, LiDAR i dziedzictwo kulturowe – zagadnienia wprowadzające. Raport 11, 239-255.
- Zapłata R., Stereńczak K. 2018. Wielkoobszarowe badania dziedzictwa archeologicznego na terenach leśnych. Kurier Konserwatorski 15. in print.
- Zapłata R., Stereńczak K., Ksepko M., Wajda S. 2018. *Puszczka Białowieska – dziedzictwo archeologiczne w świetle najnowszych badań. Od koncepcji badania zabytków archeologicznych – przez metody nieinwazyjne – po ochronę i zarządzanie zasobami kulturowymi na terenach leśnych. [Puszczka Białowieska (Białowieża Forest) – archaeological heritage in the light of latest research]*. (paper at the conference “Archeologia obszarów leśnych / The Archaeology of Woodlands”, 19-20.04.2018, Białowieża / Poland).
- Zapłata R., Szady B., Stereńczak K. (red.) 2014. *Laserowi Odkrywcy. Nieinwazyjne badanie i dokumentowanie obiektów archeologicznych i historycznych województwa świętokrzyskiego*. Stare Babice: Fundacja Centrum Geohistorii.
- Zarządzenie nr 53. Zarządzenie nr 53 Dyrektora Generalnego Lasów Państwowych z dnia 21 listopada 2011 r., obowiązujące w jednostkach organizacyjnych Lasów Państwowych od dnia 1 stycznia 2012 r. Warszawa.
- Zawadzki M. 2017. Kartografia historyczna w badaniach dziedzictwa kulturowego na wybranych obszarach RDLP w Krośnie oraz na terenach Magurskiego i Roztoczańskiego Parku Narodowego (paper at the conference „Inwentaryzacja dziedzictwa kulturowego (archeologicznego) na wybranych obszarach RDLP w Krośnie oraz na terenie Magurskiego i Roztoczańskiego Parku Narodowego 2016-2017”, 30.11.2017, Krosno).
- Zawadzki M., Stereńczak K., Zapłata R., Wajda S. 2018. *Zastosowanie archiwalnych materiałów kartograficznych i teledetekcyjnych w działaniach inwentaryzacyjnych Lasów Państwowych. Dziedzictwo kulturowe i geobaza obszarów RDLP w Krośnie*. (paper at the conference “Geomatyka w Lasach państwowych” 11-13.09.2018, Rogowo).
- Zimny M., Latalowa M., Pędzińska A., 2017. Północno-holocensiska historia lasów Rezerwatu Ścisłego Białowieskiego Parku Narodowego. In: A. Keczyński (ed.), *Lasy Rezerwatu Ścisłego Białowieskiego Parku Narodowego*. Białowieża: Białowieski Park Narodowy, 30-59.