

Social media as an opportunity or a blind alley in social communication and forest education? – Experiences from Poland

NATALIA KORCZ^{1*} AND RADOSŁAW LEWOŃ²

¹ Department of Natural Foundations of Forestry, Institute of Soil Science and Environment Management, University of Life Sciences in Lublin, Akademicka 13, 20-950 Lublin, Poland; e-mail: natalia.korc@up.lublin.pl

² Suwałki Forest District, Wojska Polskiego 1, 16-400 Suwałki, Poland; e-mail: radek.lewon@gmail.com

* Corresponding author: natalia.korc@up.lublin.pl

Korc, N. and Lewoń, R. 2021. Social media as an opportunity or a blind alley in social communication and forest education? – Experiences from Poland. *Baltic Forestry* 27(2): 289–295. <https://doi.org/10.46490/BF602>.

Received 4 August 2021 **Revised** 13 December 2021 **Accepted** 30 December 2021

Abstract

The article characterizes the experiences, problems, and prospects for the development of forest education on social media, which in Poland has been carried out by the Państwowe Gospodarstwo Leśne Lasy Państwowe (National Forest Holding ‘State Forests’) over the past several years. The activity of foresters (employees of the State Forests with a University Degree) on social media allows contact with the public, i.e. the transmission of knowledge about forests to a wide audience, a rapid response to difficult discussions, often attacking foresters about forest management taking place in public spaces. In addition, social media has great potential for communication between scientists and the public, and even for scientific collaboration (so-called citizen science; scientific research conducted, in whole or in part, by amateur scientists). As a result of training in this attractive area of social media, the passion and experience of foresters is increasing the audience on social media for State Forests every year, all of which translates into the need for evaluating and monitoring the data from passive educational methods.

Keywords: social media, forest education, informal education, environmental education, social communication, conflicts, citizen science, foresters

Introduction

Social media is playing an increasingly important role in various aspects of life, and the large and growing number of users is its strength. The most popular examples include Google.com, YouTube.com, Facebook.com, Twitter.com, and Instagram.com. According to datareportal.com, in January 2021, there were 4.20 billion social media users worldwide (53% of the world’s population), while in Poland, there were 25.90 million users (68.5% of the Polish population).

In recent years, there has been growing interest among researchers in the possibilities of using social media in marketing (Alalwan et al. 2017, Appel et al. 2020), politics (Pond et al. 2019, David 2021), health promotion (Schilling et al. 2020, Stellefson et al. 2020), and academic education (Habes et al. 2018, Chugh et al. 2021), among others. As highlighted by Daume and Fuedner (2005), social media is also beginning to play a role in forest science. Examples include research into wildlife monitoring (Daume et al. 2014, Jagiełło et al. 2019, Kolenda et al. 2021),

forest tourism and recreation (Wood et al. 2013, Pawlicz and Kubicki 2016), forest fire protection (De Longueville et al. 2009, Yue et al. 2021), and the illegal trade of wildlife (Waters and El-Harrad 2013, Siritwat and Nijman 2018).

Currently, little is known about the use of social media by foresters for public communication and forest education. And currently there are only reports of foresters using online tools (Bogdanou et al. 2013, Zeng et al. 2020). Information on the use of social media in disseminating forest knowledge has gained value over the past two years as the delivery of environmental education in the field has been curtailed due to the COVID-19 pandemic. According to Quay (2020), much of the normal education has had to move to virtual sites.

Currently, there is a growing interest among the public in management, protection, and recreation on forest lands in Poland (Orzechowski and Kamińska 2018, Jaszczak 2020), particularly in urban forests (Hunter 2001, Jaszczak and Wajchman 2015, Referowska-Chodak 2019). The public appears to want to have a real impact on forest manage-

ment tasks; however, according to Jakobsson et al. (2020), this may give rise to conflicts regarding the management of forest ecosystems, which is already manifested in the public opinion of Poles (Szwagrzyk 2019).

Forest covers 29.6% of Poland (as of 31.12.2019), of which public forests constitute 80.7%, and 76.9% of these are managed by the State Forests National Forest Holding (State Forests, SF) (Report... 2019a), which consists of the General Directorate of State Forests in Warsaw, 17 Regional Directorates, and 430 forest districts (Szczypa 2016). In Poland, since 1991, under the Forest Act, the dissemination of informal forest education is handled by the State Forests. Grzywacz (2000) defines forest education as appropriate influence on people to shape their awareness of nature, when selected aspects of forest environment are covered in teaching.

The aim of this article is to discuss the benefits, problems, and prospects of using social media in forest education by Polish foresters. The article is in the style of an overview. Our findings have both cognitive and practical implications for optimizing the use of social media in forestry, and provide support for present or future administrators, educators, and researchers from social media at the regional, national, and global levels, all of whom may be interested in conducting more effective forestry education online.

The State of Forestry education on Facebook in Poland

In 2009, the first State Forests fan page on Facebook, by the Gdansk Forest District, was created (Ciechanowicz 2010, Smarul et al. 2019), which initiated the conduct of online forest education on Facebook. The main profile of the State Forests started to run from 2010. According to Lewoń and Pirożnikow (2019), more than 200 units were active on Facebook in 2018. From 13 February–14 March 2018, the total reach of the main profile of the State Forests was 413,237 users, and the viral reach (the number of impressions of the fan page and its content that are the result of the activity of other users) was 384,478, while limited reach (the number of impressions of the page and its content without additional promotional activities) was 651,994 (Rak 2018). The State Forests fan page does not use sponsored posts (Lasy Państwowe 2019). Each year, the number of fans and the average daily reach of the posts on the main profile of the State Forests increases (Table 1). Yet, despite this, little is known about the real impact of on-

line education and communication activities conducted by foresters. According to SoTrender.com (2021), which is an analytical tool used to measure the effectiveness of communication in social media, the profile of the State Forests on Facebook has been in the top 10 governmental organisations in Poland for four years in terms of user activity, engagement, and the number of fans.

The State of Forestry education on other social media

SF foresters are also active in other social media; however, so far, they have not been described or analyzed in scientific texts. SF Foresters have been operating a YouTube channel since 2010, which, as of 04.12.2021, has reached 31.7 thousand subscriptions, 1315 videos have been published on the channel, and the total number of views has reached over 20 million (Lasy Państwowe on YouTube 2021). Since 2016, the State Forests, whose profile as of 04.12.2021 has over 38 thousand observers, are active on Instagram. During this period, 2,103 posts were published (Lasy Państwowe on Instagram 2021). In addition, since 2020, SF foresters are available on Twitter and their profiles as of 04.12.2021 are observed by more than 13 thousand users. A total of 3,683 posts were published (Lasy Państwowe on Twitter 2021).

Administrators of State Forest profiles in social media

The online activity of Polish foresters is their own initiative, which is conducted on the “margin” of their main professional activity (Lewoń and Pirożnikow 2019). In Poland, there are no legal regulations on who can run the social media of forest districts. The positive reception of shared content is the result of passion, authenticity, and the naturalness of administrators (Ciechanowicz 2011). Administrators of social media are persons (foresters), who hold various positions in the forest district, not necessarily professionally involved in forest education. Foresters can count on in-house training by experienced State Forest employees. Administrators are expected, among other things, to be committed, calm, understand the needs of their audience, and be able to write, take pictures, and record video correctly. As such, major responsibilities include planning and creating educational content, publishing posts, and engaging users in conversation by adding comments (Rak 2018).

Table 1. Statistics regarding the main profile of the State Forests on Facebook

| | Year | | | |
|--|--------------------------|--------------------------|--------------------------|---------------------------|
| | 2016 (Report... 2017) | 2017 (Report... 2018) | 2018 (Report... 2019) | 2019 (Report... 2020b) |
| Number of fans determined at the end of the year | 29,000 | 55,000 | 70,120 | 91,000 |
| Average daily reach of posts | 40,000 | 80,000 | - | 72,210 |
| Annual number of posts | 1,040 | - | 1,100 | 1,000 |

Benefits and potential of social media in forestry education

The presence of foresters on social media allows for the transfer of knowledge about forests and forest management at a low cost (Łukowski et al. 2016, Lewoń and Pirożnikow 2019), informing the public prior to undertaking tasks, responding to the needs of the public, shaping the correct image of foresters and the State Forests, resolving potential conflicts (Kopalka-Boratynska et al. 2017, Naturski and Stępińska 2018), learning about local foresters, and encouraging collective responsibility for native wildlife (Lewoń and Pirożnikow 2019).

Chamberlain's research (2018) describes well the mutual learning of Internet users and the role of the expert in informal education. Similar observations appear in Poland (Pietrzak-Zawadka and Lewoń 2018, Lewoń and Pirożnikow 2019). Social media motivates various activities in the field, promotes professional popular science literature, and enables knowledge acquisition. Moreover, users can ask nagging questions and collectively search for answers. What is interesting is that users often share photos from nature, including flora and fauna, asking for species identification, and other Internet users can help with great satisfaction, motivating others to discover nature in the field, which allows them to combine theoretical knowledge in practice. On the other hand, it should be remembered that direct contact with the forest is the best place for forest education (Lindemann-Matthies and Knecht 2011, Harris 2018). As emphasized by (Mehdipour and Zerehkafi 2013) the use of passive education methods is not sufficient to develop pro-ecological attitudes or a complete understanding of the relationships occurring in nature, because these methods only support formal education (Raut and Patil 2016). Classes conducted in the natural environment allow direct contact with forest as well as elements of forest management such as pile of wood, fence the forest crops or forest nursery the breaking of stereotypes resulting from a lack of contact with the work of foresters (Krokowska-Paluszek et al. 2018, Nwachukwu et al. 2021).

In Poland, foresters are the administrators of several Facebook groups, where, among other things, they share forestry-related content, answer questions about forest management, and help to tag species from shared photos of other users. It is important in running such groups to maintain a balance between administrative control and the freedom of users to share content, which will allow a balance between content and engagement (Lewoń and Pirożnikow 2019). When creating content, it is worth keeping in mind the 1-9-90 rule, which states that 1% of users create a lot of new content, 9% create occasionally, and 90% of users just watch (van Mierlo 2014).

Social media provides a way to connect with researchers, and sometimes even allows collaboration on fieldwork. Examples of such activities are an inventory of the praying mantis (*Mantis religiosa*) (Zielinski et al. 2018) or the squirrel (*Sciurus vulgaris*) (Kostrzewa and

Krauze-Gryz 2019). This type of research is increasingly being carried out in other parts of the world (Pace et al. 2019, Marcenò et al. 2021a, Marcenò et al. 2021b), therefore, foresters and scientists could create local groups, the scientific potential of which could be used in the future in the monitoring of invasive species (Daume and Galaz 2016) and rare species (Gonella et al. 2015, Azzurro and Tiralongo 2020, Al Mabruk et al. 2021) and in various tasks for nature conservation, e.g. field assistance in the removal of invasive species.

Weaknesses related to the use of social media in forest education

Weaknesses related to the use of social media by foresters are mainly related to site administration and communication with the public (nature conflicts). A study by Łukowski et al. (2016) shows inconsistency regarding the fan pages of individual forest districts in terms of: 1) basic information about the page, 2) profile pictures, 3) contact information and links to the official website of the particular forest district. Lack of consistency in image creation can significantly affect the overall perception of the State Forests. Administering is mainly an activity outside working hours, which relates to limited time and, consequently, a lack of regularity of published content. It would, therefore, be advisable to consider the cooperation of administrators from different units for the sake of greater regularity and improved quality of published content (Lewoń and Pirożnikow 2019, Smarul et al. 2019).

Foresters should be active on social media because of the rapid flow of information and the possibility of "feedback" from a wide audience. Conflicts are often based on an emotional connection to nature, and such emotions are good for communicating knowledge and showing a forester's passion for nature (Buijs and Lawrence 2013), which can result in numerous posts attacking forestry organisations locally and even nationally. Therefore, it is important that the forestry organisation reacts quickly [to negative commentary]. Creating content in simple language accessible for general public can dispel doubts and extinguish potential conflicts, e.g. at the local level, for example, the Forest District of Lopuchówko in Poland (Kapałka-Boratynska et al. 2017).

Social media often use catchy headlines and fake news, addressing controversial content in a biased manner, to increase the reach of given information (Chakraborty et al. 2016, Zhang and Clough 2020). Content that repeatedly attacks foresters on difficult and multifaceted topics can lead not only to misinformation but also, more importantly, to diminished public trust in educators and foresters (Lewoń and Pirożnikow 2019). Consequently, the effectiveness of forestry education, which is carried out by the State Forests, may decrease. Addressing this is particularly important during these times of climate change and emerging reports regarding the fir (*Abies alba*) as an alternative to the dying spruce (*Picea abies*)

(Marozau et al. 2021), and the cultivation of alien species (Baranowska et al. 2020).

Best practices for social media administrators

The key is to regularly create posts (Smarul et al. 2019) that enable knowledge, entertainment, social acceptance, create a social relationship, and challenge (the status quo) (Rak 2018). When creating content, language should be simple, avoiding industry-specific vocabulary. Photographs, videos, and other graphics should be of good quality and original, to make the educational content credible and better attract the audience. During the dialogue, stick to facts, concrete figures, and examples. It is useful to be inspired by local patriotism and culture (Stępińska 2019). Social media have different character limits: for Facebook it is over 60 thousand characters (Thomas et al. 2018), Instagram 2200 for captions (Gligorić et al. 2018), Twitter posts (tweets) are limited to 280 characters (Gligorić et al. 2018). In Poland, for forester social media administrators, the study by Smarul et al. (2019) recommends creating Facebook posts of 100–150 characters.

Social media administrators should elicit comments and add reactions, e.g. by asking questions, creating polls, surveys, and competitions (Smarul et al. 2019). Using hashtags (#) allows content to be grouped (Reinhardt et al. 2009), making it easier to find later.

By showing the truths that govern the natural world, the so-called Bambi syndrome, which is caused by a lack of contact of societies with nature, showing animals as poor and defenceless creatures (Lutts 1992) can be avoided. In Poland, popularization of the productive functions of the forest is often avoided, therefore, discussing wood is a good idea as an educational tool (Zawadzka 2017), and the topics should address natural, protective, and productive issues.

Conclusion

Forest education in social media thanks to the speed of content delivery and the ability to organize content and motivate users to go into the field complements formal education. However, there are still many challenges and limitations that can influence the effectiveness of online forest education as well as communication with the public. There are still no viable tools that examine the effectiveness of the information provided. Future research should focus on the characteristics of the audience, knowing their expectations, which will allow adjustment to more attractive content in the posts for the general public, maximizing the effectiveness of education. Despite the challenges of dialogue between foresters and the public on issues of conflict, the activities of foresters on social media provide a broad educational spectrum that should be developed in the future and adapted to the ever-changing expectations of the public.

References

- Al Mabruk, S.A.A., Abdulghani, A., Nour, O.M., Adel, M., Crocetta, F., Doumpas, Ni., Kleitou, P. and Tiralongo, F. 2021. The role of social media in compensating for the lack of field studies: Five new fish species for Mediterranean Egypt. *Journal of Fish Biology* 99(2): 673–678. <https://doi.org/10.1111/jfb.14721>.
- Alalwan, A.A., Rana, N.P., Dwivedi, Y.K. and Algharabat, R. 2017. Social Media in Marketing: A Review and Analysis of the Existing Literature. *Telematics and Informatics* 34(7): 1177–1190. <https://doi.org/10.1016/j.tele.2017.05.008>.
- Appel, G., Grewal, L., Hadi, R. and Stephen, A.T. 2020. The future of social media in marketing. *Journal of the Academy of Marketing Science* 48(1): 79–95. <https://doi.org/10.1007/s11747-019-00695-1>.
- Azzurro, E. and Tiralongo, F. 2020. First Record of the Mottled Spinefoot *Siganus fuscescens* (Houttuyn, 1782) in Mediterranean Waters: A Facebook Based Detection. *Mediterranean Marine Science* 21: 448–451. <https://doi.org/10.12681/mms.22853>.
- Baranowska, M., Panka, S., Korzeniewicz, R., Roszak, R., Włodarczyk, M. and Meres, B. 2020. Wybrane kępy żywotnika olbrzymiego w Puszczy Zielonce [Selected clumps of the western red cedar in The Zielonka Forest]. *Acta Scientiarum Polonorum. Silvarum Colendarum Ratio et Industria Lignaria* 19(4): 207–216 (in Polish). <https://doi.org/10.17306/J.AFW.2020.4.22>.
- Bogdanou, T., Starr, C.B., Weatherall, A. and Leslie, A.D. 2013. Use of the Internet and social media in the forestry profession in the United Kingdom. *International Forestry Review* 15: 147–159. <https://doi.org/10.1505/146554813806948521>.
- Buijs, A. and Lawrence, A. 2013. Emotional conflicts in rational forestry: Towards a research agenda for understanding emotions in environmental conflicts. *Forest Policy and Economics* 33: 104–111. <https://doi.org/10.1016/j.forpol.2012.09.002>.
- Chakraborty, A., Paranjape, B., Kakarla, S. and Ganguly, N. 2016. Stop Clickbait: Detecting and preventing clickbaits in online news media. In: Proceedings of the 2016 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM). IEEE, p. 9–16. <https://doi.org/10.1109/ASONAM.2016.7752207>.
- Chamberlain, J. 2018. Using Social Media for Biomonitoring: How Facebook, Twitter, Flickr and Other Social Networking Platforms Can Provide Large-Scale Biodiversity Data. *Advances in Ecological Research* 59: 133–168. <https://doi.org/10.1016/bs.aecr.2018.06.001>.
- Chugh, R., Grose, R. and Macht, S.A. 2021. Social media usage by higher education academics: A scoping review of the literature. *Education and Information Technologies* 26(1): 983–999. <https://doi.org/10.1007/s10639-020-10288-z>.
- Ciechanowicz, W. 2010. Blog jako narzędzie edukacji i pokonywania bariery braku zainteresowania mediów [Blog as a tool for education and bridging barriers of noninterest media]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 1(24): 93–99 (in Polish).
- Ciechanowicz, W. 2011. Media społecznościowe w edukacji przyrodniczo-leśnej [Social media in natural history and forest education]. *Głos Lasu* 1: 19–21 (in Polish).
- DataReportal. 2021. Global Digital Insights. Available online at: <https://datareportal.com> (accessed on 25 April 2021).
- Daume, S., Albert, M. and von Gadow, K. 2014. Forest monitoring and social media – Complementary data sources.

- es for ecosystem surveillance? *Forest Ecology and Management* 316: 9–20. <https://doi.org/10.1016/j.foreco.2013.09.004>.
- Daume, S. and Fuehdner, K.** 2005. “Forest Tweets” – Informal Digital Coverage of the Oak Processionary Moth or Why Foresters Should Care about Social Media. *Allgemeine Forst und Jagdzeitung* 187(9/10): 185–197.
- Daume, S. and Galaz, V.** 2016. “Anyone Know What Species This Is?” – Twitter Conversations as Embryonic Citizen Science Communities. *PLoS One* 11(3): e0151387. <https://doi.org/10.1371/journal.pone.0151387>.
- David, Y.** 2021. Public opinion, media and activism: the differentiating role of media use and perceptions of public opinion on political behaviour. *Social Movement Studies* 20: 1–21. <https://doi.org/10.1080/14742837.2021.1875321>.
- De Longueville, B., Smith, R.S. and Luraschi, G.** 2009. “OMG, from Here, I Can See the Flames!” A Use Case of Mining Location Based Social Networks to Acquire Spatio-Temporal Data on Forest Fires. In: LBSN ‘09: Proceedings of the 2009 International Workshop on Location Based Social Networks, p. 73–80. <https://doi.org/10.1145/1629890.1629907>.
- Gligorić, K., Anderson, A. and West, R.** 2018. How Constraints Affect Content: The Case of Twitter’s Switch from 140 to 280 Characters. In: Proceedings of the International AAAI Conference on Web and Social Media 12(1), p. 596–599. Retrieved from <https://ojs.aaai.org/index.php/ICWSM/article/view/15079>.
- Gonella, P.M., Rivadavia, F. and Fleischmann, A.** 2015. *Drosera magnifica* (Droseraceae): the largest New World sundew, discovered on Facebook. *Phytotaxa* 220: 257–267. <https://doi.org/10.11646/phytotaxa.220.3.4>.
- Grzywacz, A.** 2000. Edukacja leśna społeczeństwa [Forest education of the society]. *Biblioteczka leśniczego* 138: 2–26 (in Polish).
- Habes, M., Alhizzawi, M., Khalaf, R., Salloum, S.A. and Ghani, M.A.** 2018. The relationship between social media and academic performance: Facebook perspective. *International Journal of Information Technology and Language Studies* 2(1): 12–18.
- Harris, F.** 2018. Outdoor Learning Spaces: The Case of Forest School. *Area* 50: 222–231. <https://doi.org/10.1111/area.12360>.
- Lasy Państwowe on Facebook. 2021. <https://www.facebook.com/LasyPanstwowe/> (accessed on 12 June 2021).
- Lasy Państwowe on Instagram. 2021. https://www.instagram.com/lasy_panstwowe/?hl=en (accessed on 12 June 2021).
- Lasy Państwowe on Sotrender. 2021. <https://www.sotrender.com/pl/> (accessed on 17 June 2021).
- Lasy Państwowe on Twitter. 2021. <https://twitter.com/LPanstwowe> (accessed on 12 June 2021; in Polish).
- Lasy Państwowe on YouTube. 2021. <https://www.youtube.com/user/LasyPanstwowe> (accessed on 4 December 2021).
- Hunter, I.R.** 2001. What Do People Want from Urban Forestry? – The European Experience. *Urban Ecosystems* 5: 277–284. <https://doi.org/10.1023/A:1025691812497>.
- Jagiello, Z.A., Dyderski, M.K. and Dylewski, L.** 2019. What Can We Learn about the Behaviour of Red and Grey Squirrels from YouTube? *Ecological Informatics* 51: 52–60. <https://doi.org/10.1016/j.ecoinf.2019.02.006>.
- Jakobsson, R., Olofsson, E. and Ambrose-Oji, B.** 2021. Stakeholder perceptions, management and impacts of forestry conflicts in southern Sweden. *Scandinavian Journal of Forest Research* 36(1): 68–82. <https://doi.org/10.1080/02827581.2020.1854341>.
- Jaszczak, R.** 2020. Partycypacja społeczna we współczesnym leśnictwie [Social participation in contemporary forestry]. *Postępy Techniki w Leśnictwie* 148: 48–54 (in Polish).
- Jaszczak, R. and Wajchman, S.** 2015. Wybrane aspekty gospodarki leśnej w lasach miejskich Poznania i w Lasach Państwowych [Selected aspects of forest management in the urban forests of the city of Poznań and the State Forests in Poland]. *Sylwan* 159(2): 160–167 (in Polish). <https://doi.org/10.26202/sylwan.2014256>.
- Kolenda, K., Pawlik, M., Kuśmierk, N., Smolis, A. and Kadej, M.** 2021. Online Media Reveals a Global Problem of Discarded Containers as Deadly Traps for Animals. *Scientific Reports* 11: 1–10. <https://doi.org/10.1038/s41598-020-79549-8>.
- Kopalka-Boratynska, K., Sobalak, T., Wierzbicka, A. and Skorupski, M.** 2017. Czy Facebook pozwala rozwiązać konflikt społeczny? Studium przypadku konfliktu o ośrodek edukacji przyrodniczo-leśnej Nadleśnictwa Łopuchówko [Does Facebook Help to Solve Social Conflict? Case Study of a Conflict over the Łopuchówko Forest District Forest Education Center]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 50(1): 222–226 (in Polish).
- Kostrzewa, A. and Krauze-Gryz, D.** 2019. Edukacja przyrodnicza w mieście z użyciem mediów społecznościowych na przykładzie strony “Warszawskie wiewiory” [Education in a city with the help of social media – an example of fan page “Warszawskie wiewiory”]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 58(1): 51–58 (in Polish).
- Lasy Państwowe. 2017. Raport z działalności edukacyjnej Lasów Państwowych 2016 [Report on educational activities of the State Forests 2016]. Centrum Informacyjne Lasów Państwowych, Warszawa, 56 pp. (in Polish). Available online at: https://www.lasy.gov.pl/pl/informacje/publikacje/informacje-statystyczne-i-raporty/raporty-z-dzialalnosci-edukacyjnej-lasow-panstwowych/raport_educacyjny_2016.pdf/view (accessed on 12 June 2021).
- Lasy Państwowe. 2018. Raport z działalności edukacyjnej Lasów Państwowych 2017 [Report on educational activities of the State Forests 2017]. Centrum Informacyjne Lasów Państwowych, Warszawa, 32 pp. (in Polish). Available online at: <https://www.lasy.gov.pl/pl/informacje/publikacje/informacje-statystyczne-i-raporty/raporty-z-dzialalnosci-edukacyjnej-lasow-panstwowych/raport-educacyjny-2017-1.pdf/view> (accessed on 12 June 2021).
- Lasy Państwowe. 2019. Raport z działalności edukacyjnej Lasów Państwowych 2018 [Report on educational activities of the State Forests 2018]. Centrum Informacyjne Lasów Państwowych, Warszawa, 67 pp. (in Polish). Available online at: <https://www.lasy.gov.pl/pl/informacje/publikacje/informacje-statystyczne-i-raporty/raporty-z-dzialalnosci-edukacyjnej-lasow-panstwowych/raport-z-dzialalnosci-edukacyjnej-lp-2018.pdf/view> (accessed on 12 June 2021).
- Lasy Państwowe. 2020a. Raport o stanie lasów w Polsce 2019a. [Report on the State of the Forests in Poland 2019a]. Państwowe Gospodarstwo Leśne “Lasy Państwowe”. Centrum Informacyjne Lasów Państwowych, Warszawa, 181 pp. (in Polish). Available online at: <https://www.lasy.gov.pl/pl/informacje/publikacje/informacje-statystyczne-i-raporty/raport-o-stanie-lasow/raport-o-stanie-lasow.pdf/view> (accessed on 13 April 2021).
- Lasy Państwowe. 2020b. Raport z działalności edukacyjnej Lasów Państwowych 2019b [Report on educational activities of the State Forests 2019b]. Centrum Informacyjne Lasów Państwowych, Warszawa, 67 pp. (in Polish). Available online at: <https://www.lasy.gov.pl/pl/informacje/publikacje/informacje-statystyczne-i-raporty/raporty-z-dzialalnosci-edukacyjnej-lasow-panstwowych/raport-z-dzialalnosci-edukacyjnej-lp-2019.pdf/view> (accessed on 14 April 2021).
- Lewoń, R. and Pirożnikow, E.** 2019. Getting to know the potential of social media in forest education. *Forest Research*

- Papers* 80(2): 159–166. <https://doi.org/10.2478/frp-2019-0014>.
- Lindemann-Matthies, P. and Knecht, S.** 2011. Swiss Elementary School Teachers' Attitudes Toward Forest Education. *The Journal of Environmental Education* 42: 152–167. <https://doi.org/10.1080/00958964.2010.523737>.
- Lutts, R.H.** 1992. The Trouble with Bambi: Walt Disney's Bambi and the American Vision of Nature. *Forest and Conservation History* 36: 160–171.
- Lukowski, A., Opalińska, P. and Wierzbicka, A.** 2016. Aktywność nadleśnictw w mediach społecznościowych na przykładzie portal "Facebook" [Forest districts activity in social media on the example of "Facebook"]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 47(2): 209–216 (in Polish).
- Marcenò, C., Padullés Cubino, J., Chytrý, M., Genduso, E., Gristina, A.S., La Rosa, A., Salemi, D., Landucci, F., Pasta, S. and Guariono, R.** 2021b. Plant hunting: exploring the behaviour of amateur botanists in the field. *Biodiversity and Conservation* 30: 3265–3278. <https://doi.org/10.1007/s10531-021-02248-x>.
- Marcenò, C., Padullés Cubino, J., Chytrý, M., Genduso, E., Salemi, D., La Rosa, A., Gristina, A.S., Agrillo, E., Bonari, G., Giusso del Galdo, G., Iardi, V., Landucci, F. and Guarino, R.** 2021a. Facebook groups as citizen science tools for plant species monitoring. *Journal of Applied Ecology* 58: 2018–2028. <https://doi.org/10.1111/1365-2664.13896>.
- Marozau, A., Mielcarek, M., Krok, G., Paluch, R. and Chiliński, K.** 2021. European silver fir – an alternative for the dying Norway spruce in Białowieża Forest? *Folia Forestalia Polonica* 63(2): 150–166. <https://doi.org/10.2478/ffp-2021-0016>.
- Mehdipour, Y. and Zerehkafi, H.** 2013. Mobile Learning for Education: Benefits and Challenges. *International Journal of Computational Engineering Research* 3: 93–101.
- Naturski, W. and Stępińska, M.** 2018. Współczesne treści i metody edukacji leśnej [Contemporary content and methods of forest education]. In: Gil, W. and Szewczykiewicz, J. (Eds.) *Współczesne problemy komunikacji społecznej i edukacji w leśnictwie [Current problems of public communication and education in forestry]*. Zimowa Szkoła Leśna, Instytut Badawczy Leśnictwa, Sękocin Stary, p. 77–88 (in Polish). ISBN 978-83-62830-70-1.
- Nwachukwu, R.U., Agboeze, M.U., Ugwunnadi, C.M. and Ugwueze, M.O.** 2021. Social Media: An Adult Education Approach for Improving the Environmental Awareness of Timber Merchants in Udenu, Enugu State. *IOP Conference Series: Earth and Environmental Science* 730: 012022. <https://doi.org/10.1088/1755-1315/730/1/012022>.
- Orzechowski, M. and Kamińska, M.** 2018. Partycypacja społeczeństwa w planowaniu [Public participation in forest management planning in private forests]. *Sylwan* 162(4): 314–324 (in Polish).
- Pace, D.S., Giacomini, G., Campana, I., Paraboschi, M., Pellegrino, G., Silvestri, M., Alessi, J., Angeletti, D., Cafaro, V. and Pavan, G.** 2019. An Integrated Approach for Cetacean Knowledge and Conservation in the Central Mediterranean Sea Using Research and Social Media Data Sources. *Aquatic Conservation: Marine and Freshwater Ecosystems* 29: 1302–1323. <https://doi.org/10.1002/aqc.3117>.
- Pawlicz, A. and Kubicki, R.** 2016. Wykorzystanie mediów społecznościowych w marketingu terytorialnym gmin w Polsce [The use of social media in the territorial marketing of communes in Poland]. In: Sokołowski, D. and Tomczykowska, P. (Eds.) *Kreatywność w turystyce. Nowe trendy w rozwoju turystyki*. Toruń, p. 147–157 (in Polish).
- Pietrzak-Zawadka, J. and Lewoń, R.** 2018. Media społecznościowe i ich znaczenie w edukacji przyrodniczej [Social media and their role of nature education]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 20, 55(1): 86–92 (in Polish).
- Pond, P. and Lewis, J.** 2019. Riots and Twitter: connective politics, social media and framing discourses in the digital public sphere. *Information, Communication & Society* 22(2): 213–231. <https://doi.org/10.1080/1369118X.2017.1366539>.
- Quay, J., Gray, T., Thomas, G., Allen-Craig, S., Asfeldt, M., Andkjaer, S., Beames, S., Cosgriff, M., Dymont, J., Higgins, P., Ho, S., Leather, M., Mitten, D., Morse, M., Neill, J., North, C., Passy, R., Pedersen-Gurholt, K., Polley, S., Stewart, A., Takano, T., Waite, S. and Foley, D.** 2020. What future/s for outdoor and environmental education in a world that has contended with COVID-19? *Journal of Outdoor and Environmental Education* 23: 93–117. <https://doi.org/10.1007/s42322-020-00059-2>.
- Rak, B.** 2018. Rola mediów społecznościowych w kształtowaniu świadomości i postaw wobec leśnictwa [The role of social media in shaping awareness and attitudes toward forestry]. Multimedia Presentation, 26 May 2021 (in Polish). Available online at: http://www.ibles.pl/documents/10180/10948468/XZSL208_Bart%C5%82omiejski%20Rak.pdf.
- Raut, V. and Patil, P.** 2016. Use of Social Media in Education: Positive and Negative Impact on the Students. *International Journal on Recent and Innovation Trends in Computing and Communication* 4: 281–285.
- Referowska-Chodak, E.** 2019. Management and Social Problems Linked to the Human Use of European Urban and Suburban Forests. *Forests* 10(11): 964. <https://doi.org/10.3390/f10110964>.
- Reinhardt, W., Ebner, M., Beham, G. and Costa, C.** 2009. How people are using Twitter during conferences. In: Hornung-Prähauser, V. and Luckmann, M. (Eds.) *Creativity and Innovation Competencies on the Web. Proceeding of 5. EduMedia conference*. Salzburg, p. 145–156. Available online at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.148.1238&rep=rep1&type=pdf>.
- Siriwat, P. and Nijman, V.** 2018. Illegal Pet Trade on Social Media as an Emerging Impediment to the Conservation of Asian Otters Species. *Journal of Asia-Pacific Biodiversity* 11: 469–475. <https://doi.org/10.1016/j.japb.2018.09.004>.
- Smarul, N., Tomczak, K., Wierzbicka, A. and Lukowski, A.** 2019. Możliwości i stopień wykorzystania portalu Facebook przez nadleśnictwa Lasów Państwowych [Possibilities and level of use of Facebook by the State Forests]. *Sylwan* 163(7): 542–550 (in Polish). <https://doi.org/10.26202/sylwan.2018154>.
- SoTrender.com.** 2021. SoTrender, the AI-powered tool to master your social media presence. URL: <https://www.sotrender.com/pl/>.
- Starosta-Grała, M. and Ankudo-Jankowska, A.** 2016. Prawne uwarunkowania edukacji przyrodniczo-leśnej w Polsce [Legal conditions of forest education in Poland]. *Acta Scientiarum Polonorum Silvarum Colendarum Ratio et Industria Lignaria* 15: 175–183 (in Polish). <https://doi.org/10.17306/J.AFW.2016.3.20>.
- Stępińska, M.** 2019. Edukacja leśna online [Forest education online]. In: Janeczko, E. and Woźnicka, M. (Eds.) *Edukacja ekologiczna w kształtowaniu świadomości społeczeństwa*. Warszawa, p. 167–179 (in Polish).
- Szczypa, P.** 2016. Istota i rodzaje pożądanych zmian w rachunkowości Lasów Państwowych [The essence and types of desired changes in the accounting of the State Forests].

Studia Ekonomiczne. Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach 300: 174–182.

- Szwagrzyk, J.** 2019. Polski model leśnictwa wobec nowych wyzwań w szybko zmieniającym się świecie. Referat z sesji naukowej pt: “Wielofunkcyjna gospodarka leśna wobec oczekiwań przemysłu drzewnego i ochrony przyrody” [The Polish model of forestry in the face of new challenges in a rapidly changing world. Paper from the scientific session entitled: “Multifunctional forest management in the face of the expectations of the wood industry and nature protection”]. Z okazji 119 Zjazdu Polskiego Towarzystwa Leśnego w DarłóWKu, 12–14 September 2019, No 119, p. 12–14 (in Polish).
- Thomas, R.B., Johnson, P.T. and Fishman, E.K.** 2018. Social media for global education: pearls and pitfalls of using Facebook, Twitter, and Instagram. *Journal of the American College of Radiology* 15(10): 1513–1516. <https://doi.org/10.1016/j.jacr.2018.01.039>.
- Van Mierlo, T.** 2014. The 1% Rule in Four Digital Health Social Networks: An Observational Study. *Journal of Medical Internet Research* 16: e33. <https://doi.org/10.2196/jmir.2966>.
- Waters, S. and El-Harrad, A.** 2013. A Note on the Effective Use of Social Media to Raise Awareness against the Illegal Trade in Barbary Macaques. *African Primates* (8): 67–68.
- Wood, S.A., Guerry, A.D., Silver, J.M. and Lacayo, M.** 2013. Using social media to quantify nature-based tourism and recreation *Scientific Reports* 3: 2976. <https://doi.org/10.1038/srep02976>.
- Yue, Y., Dong, K., Zhao, X. and Ye, X.** 2021. Assessing wildfire risk in the United States using social media data. *Journal of Risk Research* 24(8): 972–986. <https://doi.org/10.1080/13669877.2019.1569098>.
- Zawadzka, A.** 2017. Promocja drewna – zagadnienie, które powinno być poruszane w edukacji leśnej? [Promotion of wood – an issue that should be discussed in forest education?]. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 19 50(1): 168–175 (in Polish).
- Zeng, M.Q.M., Chen, H., Shrestha, A., Crowley, C., Ng, E. and Wang, G.** 2020. International Collaboration on a Sustainable Forest Management OER Online Program-A Case Study. *Journal of Higher Education Theory and Practice* 20(8): 120–128. <https://doi.org/10.33423/jhetp.v20i8.3235>.
- Zhang, C. and Clough, P.D.** 2020. Investigating Clickbait in Chinese Social Media: A Study of WeChat. *Online Social Networks and Media* 19: 100095. <https://doi.org/10.1016/j.osnem.2020.100095>.
- Zielinski, D., Schwarz, C.J. and Ehrmann, R.** 2018. Evaluation of the Expansion of *Mantis religiosa* (L.) in Poland Based on a Questionnaire Survey. *Animal Biodiversity and Conservation* 41: 275–280. <https://doi.org/10.32800/abc.2018.41.0275>.