T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Thursday, 27 June 2024, 08:30 - 10:30 CEST
B2 – Theme 4: Forests for sustainable societies

Information

Armed conflicts constitute a serious threat forests, forestry and foresters as well as rural population near forests in all continents. Direct impacts of armed conflicts include physical damage of forests by shelling, movements and positioning of heavy military equipment. Indirect impacts include long-term contamination of forests by unexploded ordnance (UXO), land mines and chemical contaminants, which pose high risks to the life and health of foresters and local populations working on or visiting contaminated lands. Contaminated forests and surrounding open-land territories must be mapped, delineated, clearly marked, access prohibited and eventually fenced.

The session will address experiences and solutions for forest management and forest policies during and after wars and other armed conflicts. The contributions will highlight:

- Adaptation of forest management to modern challenges;
- Methods and technologies for identification and mapping of dangerous forests area affected by military conflicts;
- Technologies of demining and rehabilitation of forest landscapes;
- Social and economic aspects of forest management in the zones of armed conflicts;
- Use of remote sensing and geospatial technologies for health, dynamic and productivity monitoring of forests;
- Fire and pest management;
- Prognosis of long-term dynamics of forests affected by climate change and war impact;
- Assessment of impact on ecosystem services for forests in zones of military conflicts.

Moderators
Pavlo Kravets and Oleksandr Soshenskyi
on behalf of Sergiy V. Zibtsev and Johann Georg Goldammer

Presentations

Sub-session 1: Impact of Armed Conflict on Forests and Forestry

Oleksandr Soshenskyi on behalf of Sergiy V. Zibtsev and Johann Georg Goldammer
- Armed Conflicts, Climate Change, Wildfires and Human Security in the Cultural Landscapes of Temperate-Boreal Eurasia

Maksym Matsala
- Damage to Ukraine's forests due to Russian aggression: estimates for the year 2022 based on satellite data

Serhii Sydorenko
- Postfire forest management: science-based assessment, monitoring and restoration

Sergiy Zibtsev
- Impact of war in Ukraine on wildfire regimes, fire management and carbon emissions

Oleksandr Soshenskyi
- Contribution of FirEUrisk project to risk assessment and prevention of forest fires in the Chornobyl Exclusion Zone

Nickolai Denisov
- Preliminary assessment of environmental damage during the war in Ukraine in 2022

Sub-session 2: Post War Reconstruction

Nickolai Denisov
- Demining of Ukrainian forests

Maksym Matsala
- Towards developing forest monitoring capacity in Ukraine in the post-war reality

Christian Rosset
- Enhancing Close-to-Nature Silviculture in Ukraine: The Utility of martelage.sylvotheque.ch in Fostering Post-War Forest Recovery

Mariana Melnykovych
- Seeing the Forest for the Trees: A Multi-Actor Approach to Trigger Sustainable Forest Governance in Post-War Ukraine

Pavlo Kravets
- Adaptation of forest management system under the armed conflict in Ukraine

Pavlo Kravets
- Concluding remarks

T4.20 Session Group – Stockholm – 27 June 2024

XXVI IUFRO World Congress
27 June 2024

Results of Session T4.20 "Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science"

Moderators: Pavlo Kravets, Oleksandr Soshenskyi

Armed conflicts constitute a serious threat to forests, forestry and foresters as well as rural populations near forests in all continents. Direct impacts of armed conflicts include physical damage of forests by shelling, movements and positioning of heavy military equipment. Indirect impacts include long-term contamination of forests by unexploded ordnance (UXO), land mines and chemical contaminants, which pose high risks to the life and health of foresters and local populations working on or visiting contaminated lands. Contaminated forests and surrounding open-land territories must be mapped, delineated, clearly marked, access prohibited and eventually fenced.

The session was addressed experiences and solutions for forest management and forest policies during and after wars and other armed conflicts. The session covered the following topics:

- Adaptation of forest management to modern challenges;
- Methods and technologies for identification and mapping of dangerous forest areas affected by military conflicts;
- Technologies of demining and rehabilitation of forest landscapes;
- Social and economic aspects of forest management in the zones of armed conflicts;
- Use of remote sensing and geospatial technologies for health, dynamic and productivity monitoring of forests;
- Fire and pest management;
- Prognosis of long-term dynamics of forests affected by climate change and war impact;
- Assessment of impact on ecosystem services for forests in zones of military conflicts.

The session started with a remark about the two-year preparation work that had been done for organizing of the session by Prof. Sergiy Zibtsev (NUBiP/REEFMC) and Prof. Johann G. Goldammer (GFMC). The T4.20 Session preceded by the top level international event *"Forum on Ukraine Forest Science and Education: Needs and Priorities for Collaboration"*, 21-22 November 2023, IIASA, Laxenburg, Austria organized jointly by IIASA, National University of Life and Environmental Sciences of Ukraine (NUBiP) and IUFRO. The road map for support of Ukrainian science and education was developed as an output of the Forum (see: https://www.iufro.org/events/other-major-events/forum-on-ukraine-forest-science-and-education-needs-and-priorities-for-collaboration/)

During the opening of the Session, the President of IUFRO Dr. John Parrotta awarded Prof. Sergiy Zibtsev for his outstanding commitment to maintaining and enhancing forest research and education in Ukraine, by fostering international cooperation as Chair of the Ukraine Forum on Forest Science and Education.

The session consisted of two sub-sessions: 1) Impact of Armed Conflict on Forests and Forestry; 2) Post War Reconstruction with presenting 11 oral talks.

Key outcomes of the session

1. Armed conflict creates complex destructive impacts not only for forests and forestry, but also for people and infrastructure. The negative effects of war resulted in massive deforestation around frontline, forest degradation due to shelling, mechanical damage, landscape fires and other war related disturbances, reduced resilience of forests to climate change and fires, and reduced ecosystem services, including carbon storage.

2. The direct consequences of the armed conflict in Ukraine include the destruction of forest ecosystems, a significant increase in wildfires and the contamination of a large area with unexploded ordnance which limits Forest Management as well as Forest Fire Management.

3. Such areas are beyond the control of forestry personal. Holistic solutions involving local administrations and competent authorities are needed in the context of the increasing role of forests for firewood supply, recreation and non-timber products.

4. Research and scientific support for management decision-making must be based on scientifically proven data, remote sensing results.

5. Through international cooperation, Landscape Fire Monitoring and Advisories and RS-Inventory services are now available in Ukraine (see REEFMC web-site https://nubip.edu.ua/node/9087/2).

6. Contamination of forests by UXO is a main problem of post war rehabilitation. Priority for demining are villages, agriculture lands and after them - forests. Adaptive forest management, with additional control and training measures, is becoming increasingly important in this context. One proposed solution for adapting the Forest Management System in Ukraine is to exclude areas contaminated by unexploded ordnance from the scope of FSC certification until they will be cleaned from UXO.

7. Wide involving stakeholders in preparation and decision-making to minimize risks for forest personal and local population are an important factor in increasing safety of peoples and cultivating democratic practices.

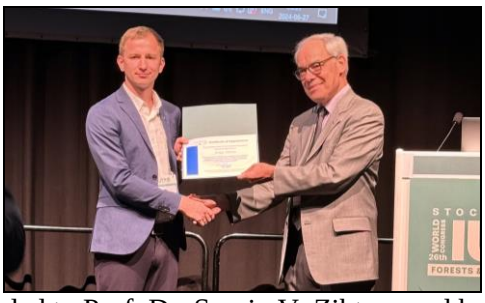
8. International cooperation is important for the integration of Ukrainian forest science and education with the European and world institutions that contributes to the development of a new projects aimed in study the impact of war on forests and forestry, as well as their rehabilitation.

9. The transformation of silvicultural approaches to close-to-nature forestry should be followed by forest monitoring and the development of adaptive practices responding to climate change.

10. Support for young scientists remains very important. In this context, it is important to implement the proposals set out in Forest Science and Education in Ukraine – Priorities for Action (https://iiasa.ac.at/policy-briefs/apr-2024/forest-science-and-education-in-ukraine-priorities-for-action).

11. Despite the extraordinary situation, Ukrainian forestry scientists continue their mission. To save forest science capacity in Ukraine permanent support of international and national organizations, donors and research programs required.

Prepared by Dr. Pavlo Kravets and Dr. Oleksandr Soshenskyi



The IUFRO Certificate of Appreciation was awarded to Prof. Dr. Sergiy V. Zibtsev and handed over by IUFRO President John Parotta to Dr. Oleksandr Soshenskyi

ABSTRACTS

Armed Conflicts, Climate Change, Wildfires and Human Security in the Cultural Landscapes of Temperate-Boreal Eurasia

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Johann Georg Goldammer[1] , *Sergiy Zibtsev*[2, 3], *Nikola Nikolov*[4]

[1] Global Fire Monitoring Center (GFMC), Freiburg, Germany

[2] Regional Eastern Europe Fire Monitoring Center (REEFMC), Kyiv, Ukraine

[3] National University of Life and Environmental Sciences of Ukraine (NUBiP), Kyiv, Ukraine

[4] Regional Fire Monitoring Center (RFMC) for Southeast Europe and Caucasus, Skopje, North Macedonia

Abstract

Cultural landscapes of temperate-boreal Eurasia, which were formed by traditional agrarian societies over centuries, are undergoing rapid changes. Rural exodus and the accelerating trend of urbanization in some regions are associated with abandonment of land cultivation and thus directly or indirectly affecting fire regimes in some regions. Climate change is contributing to aggravation of wildfire risk and wildfire severity. This contribution looks at the specific issues linked to the heritages of civilization including industrial and nuclear accidents and armed conflicts in temperate-boreal Eurasia.

In Europe, armed conflicts have resulted in collateral damages, including wildfires, and left behind significant areas contaminated by unexploded ordnance (UXO). In regions affected by military operations, UXO and land mines constitute a major problem for post-conflict forest management and fire management. Over more than a Century, large territories have been affected by collateral wildfire damages during wars. Wildfires occurring on lands contaminated by UXO and land mines as consequences of armed conflicts are posing high risk to human security. Examples are provided from the Western Balkans (World War I and military conflicts related to the dissolution of Yugoslavia 1991-2001), Central and Eastern Europe (World War II and military activities during the Cold War), South Caucasus (dissolution of the Soviet Union and recent armed conflicts) and Ukraine (since 2022).

In the early 2000s, the Global Fire Monitoring Center (GFMC), which was established in1998 to serve the science-policy interface towards developing informed fire management policies, governance and practices, started addressing fire management solutions in conflict and post-conflict areas. Besides developing technological and managerial solutions, the GFMC is facilitating cross-boundary cooperation in fire management for confidence-building and peacekeeping in regions of political and military tensions. In the light of socio-economic changes, land-use change and the climate crisis, the collateral damages and remnants of war constitute a major challenge for regional and international security. Joint bilateral, regional and international cooperative projects and programs in landscape fire science, integrated landscape fire management and policy development are exemplary for realizing joint interests in environmental protection, wildfire disaster risk reduction and sustainable integrated fire management capabilities.

Damage to Ukraine's forests due to Russian aggression: estimates for the year 2022 based on satellite data

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Maksym Matsala[1] , *Andrii Odruzhenko[2], Taras Hinchuk[3], Viktor Myroniuk[2], Igor Drobyshev[1], Sergii Sydorenko[4], Sergiy Zibtsev[2], Brian Milakovsky[5], Dmitriy Schepaschenko[6], Florian Kraxner[6], Andrii Bilous[2]*

[1] Swedish University of Agricultural Sciences, Southern Swedish Forest Research Center, Sweden

[2] National University of Life and Environmental Sciences, Education and Research Institute of Forestry and Landscape-Park Management, Ukraine

[3] Ukrainian Hydrometeorological Insitute, Department of Environmental Radiation Monitoring, Ukraine

[4] Ukrainian Research Institute of Forestry and Forest Melioration, Department of Forest Ecology, Ukraine

[5] Independent forest management and ecology consultant, United States of America

[6] International Institute for Applied Systems Analysis, Agriculture, Forestry, and Ecosystem Services Research Group, Austria

Abstract

The Russian-Ukrainian war (since 2022) has already entailed multiple negative consequences for Ukraine's natural environment. Shelling and accompanying fires have reportedly ravaged agricultural and grassland ecosystems in vicinity to active battles. Resulting fires, mechanical shelling damage, and tree harvest for fortification purposes severely fragmented Ukrainian forest landscapes that are already a complex mosaic. The greatest amount of damage was reported along the frontline in southern and eastern regions of Ukraine. However, also severe wildfires occurred in Chornobyl Exclusion Zone (CEZ, north of Ukraine) after Russian forces left it in April 2022.

We estimated damage to forests in three areas of interest (AOI): East (20 counties in Donetsk, Luhansk, and Kharkiv regions); Kherson (8 counties in Kherson and Mykolaiv regions); CEZ. We used Sentinel-1 and Sentinel-2 imagery to predict pre-war land cover and derive a forest mask, and high-resolution satellite imagery to digitize visually damaged forest cover. We calibrated a binary classification model using spectral Sentinel-2 to determine the difference between August-September medians for the years 2021 and 2022. Our model derived damage estimates with 88% overall accuracy.

24,180 ha were damaged in East AOI (9% of 2021 forest cover). Damage estimates for Kherson AOI (7,293 ha, or 16% of pre-war forests) and CEZ (7,116 ha, or 5% of 2021 forest cover) are similar. Additionally, we found that 89% of damaged forest patches in Kherson AOI are highly fragmented and share an edge with highly-flammable open landscapes. For East AOI and CEZ this estimate is lower, at 70%.

Forests in southern and eastern parts of Ukraine are extremely crucial for the ecological functioning of local landscapes. Precise estimation of war-related damage is important for designing post-conflict forest regeneration.

Postfire forest management: science-based assessment, monitoring and restoration

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Serhii Sydorenko[1] , *Ihor Budzinskyi*[2], *Yevhen Melnyk*[1], *Ihor Tymoshchuk*[1]

[1] Ukrainian Research Institute of Forestry and Forest Melioration named after G. M. Vysotsky (URIFFM), Kharkiv, Ukraine

[2] State Forest Resource Agency of Ukraine, Kyiv, Ukraine

Abstract

Due to the climate change, the risk of forest fires in Ukraine remains high while the massive military Russian invasion multiplied those risks. Therefore it`s relevant to develop science-based silviculture approach to mitigate loses caused by wildfires. This creates additional risks for human safety and health. Forest health deterioration of the damaged stands leads to significant economic (losses of timber that can be obtain after salvage logging) and ecological losses (forests after severe wildfires are not able to fully provide most of ecosystem services).

As a result of forest fires, areas with completely or partially dead stands are formed. If, in the first case, forestry treatments are focused of salvage logging of stands and reforestation of these areas, then in the second case, decision-making process is more complicated. To evaluate the post-fire development of burnt areas and the possibilities of their restoration, researchers from URIFFM have developed a set of recommendations and guidelines to support postfire assessment and forest restoration for different climatic conditions (including restoration in severe condition of South Steppe) and specific natural features of each area. Multiple regression analysis as well as logistic regression analysis were used to develop tree mortality models. Postfire monitoring (forest health monitoring) of damaged stands are performed using remote sensing methods. Similar approach with the active use of LIDAR and optical sensors now also under development (Myroniuk, Zibtsev, 2023).

To predict tree mortality and the possibility of damaged forest to restoration, an experimental three level framework was proposed: I) stand level – prediction of the share of trees that will die, depending on the type and intensity of fire damage as well as forestry characteristics of tree stand (age, DBH etc.); II) individual level – estimating the mortality probability of each tree in the same stand; III) remote level – monitoring of forest health changes of each damaged stand for several years (up to six years) after the fire (vegetation indices for the control period and after fire damage were used).

These approaches combined with adequate forestry treatment can be used to significantly mitigate both ecological and economical losses caused by forest fires.

Impact of war in Ukraine on wildfire regimes, fire management and carbon emissions

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Sergiy Zibtsev[1, 2] , *Johann Goldammer*[3], *Viktor Myroniuk*[1], *Oleksandr Soshenskyi*[1, 2], *Roman Vasylyshyn*[1], *Nickolai Denisov*[4], *Vasyl Gumeniuk*[1, 2], *Serhii Sydorenko*[5], *Oleksandr Borsuk*[6], *Volodymyr Braiko*[7], *Iryna Zibtseva*[2]

[1] National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine

[2] Regional Eastern European Fire Monitoring Center (REEFMC), Kyiv, Ukraine

[3] Global Fire Monitoring Center (GFMC) and Max Planck Institute for Chemistry and Freiburg University, Freiburg, Germany

[4] Zoï Environment Network, Geneva, Switzerland

[5] Ukrainian Research Institute of Forestry and Forest Melioration (URIFFM), Kharkiv, Ukraine

[6] Chornobyl Radioecological Biosphere Reserve, Chornobyl, Ukraine

[7] Chernihiv Branch of the State Company “Forests of Ukraine”

Abstract

Military aggression of Russian Federation against Ukraine heavily impacted forests and fire regimes of landscapes. Direct impacts included shelling, mechanical damage of trees and soils, trenches, increasing ignition sources as collateral damages during combat. Indirect impact resulted in unaddressed fires on occupied territories during weeks, loss and limitation of fire management capacities, lack of personal and equipment, contamination of large areas of forests with unexploded ordnance and land mines that pose high risk for personnel. For assessment of impact of war, all fires in Ukraine in 2022 were manually delineated and classified using Sentinel 2 imagery. We defined three discrete burn severity classes using the following delta NBR (Normalized Burn Ratio) thresholds: low (0.090-0.179), medium (0.180-0.549), and high (0.550 and higher). The Copernicus Dynamic Land Cover map was used to attribute the burned area to a specific land cover (coniferous forests, deciduous forests, croplands, other natural vegetation, and urban territories). Average values of burn severity obtained for each land cover type were used in carbon loss calculations over Ukraine. Carbon emissions were estimated using averaged data on the structure of forest biomass (Shvidenko et al., 2014) and yields of agricultural lands. The total area of landscape fires in Ukraine during 2022 reached 755 638 ha, including croplands (419 313 ha), forests (56 719 ha), and abandoned lands (273 987 ha). In total 19 948 fires were occurred. They were mostly (50.3%) burned within 60-km buffer zone along a daily front line, while 42.3% of all fires occurred in occupied territories. The war directly affected about 25% of the protected areas of Ukraine. The area of fires burned on the Emerald Network reached 88 427 ha. Over entire Ukraine, landscape fires in 2022 resulted in more than 1.3 million tons of carbon emissions. Almost 48% of carbon emissions were caused by fires within occupied territories of Ukraine. We expect that fuel loads in landscapes due to the impacts of war will create high risks of wildfires at level of emergency situations, similar to 2020. In future, the development of a national interagency system of landscape fire monitoring and management is required.

Contribution of FirEUrisk project to risk assessment and prevention of forest fires in the Chornobyl Exclusion Zone

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Oleksandr Soshenskii[1, 2] , *Domingos Viegas*[3], *Viktor Myroniuk*[1, 2], *Dmytro Holiaka*[1, 4], *Valerii Kashparov*[2, 4], *Serhii Sydorenko*[1, 5], *Vadim Bogomolov*[1, 5], *Oleksandr Borsuk*[6]

[1] Regional Eastern Europe Fire Monitoring Center (REEFMC), Kyiv, Ukraine

[2] National University of Life and Environmental Sciences of Ukraine (NUBiP), Kyiv, Ukraine

[3] Associação Para O Desenvolvimento Da Aerodinâmica Industrial (ADAI), Porto, Portugal

[4] Ukrainian Institute of the Agriculture Radiology (UIAR) of NUBiP, Chabany, Ukraine

[5] Ukrainian Institute of Forestry and Forest Melioration after G.M.Vysotskii (URIFFM), Kharkiv, Ukraine

[6] Chornobyl Radiation and Ecological Biosphere Reserve, Ivankiv, Ukraine

Abstract

The Chornobyl Exclusion Zone (CEZ) were established after the disaster 26 of April 1986 that contaminated of environment by radionuclides (RN): Sr-90, Cs-137, Pu-238-240, Am-241. The CEZ territory was fenced with area 260 000 ha, including most contaminated 10-km core zone around ChNPP. Special State Forestry Enterprise “Chornobyl Forestry” were established to prevent radioactive forest fires. Due to climate change and lack of funding regular large fires have been occurred in CEZ: 1992 (17000 ha), 2003 (5000 ha), 2015 (15000 ha), 2016 (1200 ha), 2020 (80 000 ha). Russian military invasion 24.02.22 resulted in damage fire engines and contamination of CEZ with unexploded ordnance (UXO) and land mines. From 12 forest fire stations only 2 left undamaged with few fire engines.

While details maps of radioactive contamination exist and allow to predict doses for fire personal, unexploded ordnance (UXO) and land mines were not mapped and create huge uncertainties and high risks for life and health of firefighters and engines. Under these conditions scientific products (models, data sets, maps), special technologies of prescribe burning and armored vehicles to protect fire personal from UXO are only solution to manage risks and prevent fires.

EU Horizon FirEUrisk project (project number 101003890) will develop, evaluate and disseminate a science-based integrated strategy to: 1) expand current wildland fire risk assessment systems, including critical factors of risk previously not covered; 2) produce effective measures to reduce current fire risk conditions, and 3) adapt management strategies to expected future climate and socioeconomic changes.

Regional Eastern Europe Fire Monitoring Center (REEFMC) within the project developed two products and DSS to address risk for personal and forests from fires in CEZ: 1) Combining Landsat time series and GEDI data for improved characterization of fuel types and canopy metrics in wildfire simulation; 2) Modelling of the extinction moisture content for main fuel types of the CEZ; 3) DSS system for prevention and safe suppression of radioactive fires on terrains contaminated by UXO. All products will be demonstrated in CEZ and extended on larger area of Ukrainian Polissia based on Ukrainian Landscape fires portal (www.wildfires.org.ua).

Preliminary assessment of environmental damage during the war in Ukraine in 2022

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Nickolai Denisov[1] , *Doug Weir*[2]

[1] ZOI Network, Geneva, Switzerland

[2] The Conflict and Environment Observatory (CEOBS), United Kingdom

Abstract

Russia's war against Ukraine has had devastating humanitarian, social, economic and environmental consequences. The OSCE preliminary assessment of the environmental damage and risks caused throughout the first year of the war between February 2022 and February 2023 has contributed to shaping response and recovery planning in Ukraine. The report has covered the environmental context before February 2022; military conduct; the impacts of the war on industrial and energy infrastructure, nuclear facilities and other radioactive sources, the built environment, the rural environment, freshwater resources and infrastructure, the coastal and marine environment and the climate and climate policies; as well as the evolving legal and regulatory environments.

Although the dynamics of the war varied throughout the year, it remained a high intensity armed conflict characterized by severe damage to settlements, environmentally hazardous infrastructure and landscapes. Long-range weapons affected sites nationwide, while the indiscriminate use of explosive force devastated areas along mobile and static front lines.

The war has seen the unprecedented occupation of current and former nuclear energy-generating sites, and underscored the range of direct and indirect threats to nuclear and radiation safety, and nuclear security, which can be triggered by armed conflicts.

Alongside the environmental damage linked to the fighting itself, natural resources and geographical features proved strategically important for the conflict parties. This included woodlands and forestry, rivers, canals, reservoirs and coasts, offshore islands and infrastructure, agricultural shelter belts and industrial spoil heaps. The use, targeting and militarization of these features contributed to environmental harm. Fighting also affected nationally and regionally important habitats and protected areas, with a wide range of direct and indirect impacts.

Based on the findings and an assessment of Ukraine's needs, the report suggested a set of specific recommendations for improving the information and knowledge base, building Ukraine's capacity for assessing and addressing the environmental impacts of the warm, and mainstreaming the environment in recovery policies and planning altogether.

Demining of Ukrainian forests

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Hansjorg Eberle[1] , *Nickolai Denisov*[2]

[1] FSD, Geneva, Switzerland

[2] ZOI Network, Geneva, Switzerland

Abstract

Humanitarian demining is high on the agenda of Ukraine and its allies, as it is the unsurmountable condition for fully reclaiming the territories that have been freed from occupation or simply used to be close to front lines for an extended period of time. Without demining roads, settlements and agricultural fields, neither normal everyday life nor economic activities can fully resume, as large areas will remain mortally dangerous or inaccessible. Yet a large part of country that has suffered from the war still lacks such attention: these are Ukraine's forests and other natural landscapes. Not the responsibility of the State Emergency Service, forest lands are left to the devices of forest management authorities, who are overstretched with their core tasks and do not possess the expertise, capacities and indeed the budget for carrying out demining operations at the required scale. The contamination of Ukraine's forests with landmines and unexploded ordnance already regularly puts at risk and kills forest guards and local inhabitants. And as long as forests will remain contaminated, neither regular maintenance nor emergency interventions, e.g., in case of fire, are going to be possible. While the former endangers forest conditions in the longer-term perspective, the latter bears the tangible risks of losing even more forest land than what has already been lost during the war. The contaminated forests will remained barred for the local population, depriving people of their essential livelihoods and recreational resources. Even more critically, the mined forests will continue to put at risk those who dare to venture into the dangerous terrain notwithstanding warning signs and roadblocks. Children are particularly prone to such behaviour. For an effective response to this large-scale challenge, a collective international effort is needed to specifically focus on surveying and demining Ukraine's forests. Along with that, urgent and systematic efforts are required to make people fully aware of the risks and to help them contribute to their mitigation.

Towards developing forest monitoring capacity in Ukraine in the post-war reality

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Viktor Myroniuk[1] , *Sergiy Zibtsev*[1, 2], *Viktor Melnychenko*[3]

[1] National University of Life and Environmental Sciences of Ukraine (NUBiP), Kyiv, Ukraine

[2] Regional Eastern Europe Fire Monitoring Center (REEFMC), Kyiv, Ukraine

[3] State Forest Management and Planning Enterprise, Ukraine

Abstract

Effective post-war forest management in Ukraine requires accurate and timely information on forests in a spatially explicit form. Since 2022, large forests in Ukraine have been affected by the russian invasion, leading to increased vulnerability of forest stands under climate change or total forest loss in the war zone. Assessment of the impact of the war on the environment and decision-making can be supported by the use of innovative solutions. Forest monitoring capacity in Ukraine can be strengthened through close scientific cooperation with the international community, technology exchanges, and training.

Large areas in Ukraine will remain restricted by landmines and unexploded ordnance, so forest monitoring requires more advanced use of remote-sensing data. Since forest inventory information cannot be collected in such areas, research into advanced technologies to propagate spatially explicit estimates becomes crucial. Thus far, efforts in Ukraine have been fragmented and therefore ineffective for long-term management. The forest information in Ukraine in the post-war period is expected to be little updated. To improve the situation in the future it is important to update data collection with innovative solutions. Satellite time series and airborne scanning technologies (i.e., LiDAR) can provide strong support for strategic forest inventories to inform forest management. Thus, there should be a systematic basis for regularly updating forest information in accordance with new disturbances, as well as forest growth forecasts.

Forest monitoring technologies based on the combined use of forest inventory data, satellite time series and LiDAR scanning data have been used in many developed countries, so their experience can reinforce the potential of forest monitoring in Ukraine. We also note professional expertise as an important component of strengthening forest monitoring capacity in Ukraine. This can be improved by developing the essential skills through trainings involving leading international experts.

Enhancing Close-to-Nature Silviculture in Ukraine: The Utility of martelage.sylvotheque.ch in Fostering Post-War Forest Recovery

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Christian Rosset[1] , *Oleksandr Soshenskyi*[2], *Mariana Melnykovych*[1]

[1] Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences BFH-HAFL, Switzerland

[2] National University of Life and Environmental Sciences of Ukraine NUBIP, Education and Research Institute of Forestry and Park Gardening, Ukraine and Regional Eastern Europe Fire Monitoring Center REEFMC, Ukraine

Abstract

Close-to-nature silviculture (CTNS) covers a broad variety of techniques that rely on natural processes to influence forest development to provide essential forest ecosystem services. A profound understanding of forest ecosystems and their underlying processes is crucial, alongside the ability to adapt to local conditions and choose appropriate silvicultural methods that align with societal and forest owner expectations. Creativity plays a vital role in discovering innovative approaches to climate adaptation and enhancing resilience, particularly in Ukraine, where 690,000 ha of forest affected due to the war.

This paper presents the potential of combining the "marteloscope" concept with digitalization to train forest students and practitioners in Ukraine to address the challenges of post-war forest recovery.

The “marteloscope” concept has proven to be useful for teaching CTNS. It helps to enhance knowledge, but also to develop ones “own know-how”. A large network of marteloscopes is useful to cover the manifold aspects of CTNS. Digitalization has been instrumental in establishing and managing such network, enabling data analysis, comparisons of marteloscopes, and promoting experience sharing both in the forest and through virtual reality. The *martelage.sylvotheque.ch* (MSC) internet platform, along with the complementary *MSC Mobile smartphone app*, were developed for this purpose. Currently, there are over 200 marteloscopes in four countries.

With extensive experience in applying CTNS in Switzerland and leveraging digitalization, BFH-HAFL has developed a course of action in collaboration with NUBIP to support Ukrainian forest stakeholders in building capacity for post-war recovery. Through workshops and knowledge transfer events, we have shared Swiss expertise with Ukrainian researchers, students, and practitioners. *Martelage.sylvotheque.ch* has served as a catalyst for promoting CTNS among Ukrainian stakeholders. We have successfully established a dedicated network of researchers and practitioners committed to implement CTNS in Ukraine. The potential and limitations of Marteloscope and MSC have been assessed, and efforts to establish MSC plot networks are underway. Our next objective is to develop guidelines on different CTNS approaches and elaborate training concepts for students and practitioners. By facilitating knowledge sharing with policy makers, we will promote CTNS principles into forest management practices in Ukraine, fostering sustainability and resilience in post-war forest recovery endeavors.

Seeing the Forest for the Trees: A Multi-Actor Approach to Trigger Sustainable Forest Governance in Post-War Ukraine

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Mariana Melnykovych[1, 2] , *Maria Nijnik[3], Sergiy Zibtsev[4], Olexandr Soshensky[5], Lesya Loyko[6], Roman Jaroschuk[7], Radmila Ustych[6], Vasyl Lavnyy[8], Ivana Živojinović[9, 10], Claude A. Garcia[1, 11], Patrick O. Waeber[1]*

[1] Bern University of Applied Sciences, Agricultural, Forest and Food Sciences, Switzerland

[2] CAS Rebuild Ukraine Program, Switzerland

[3] James Hutton Institute, United Kingdom

[4] Regional Eastern Europe Fire MonitoringCenter (REEFMC), Ukraine

[5] National University of Life and Environmental Sciences of Ukraine

[6] NGO FORZA, Agency for the development of the Carpathian region, Ukraine

[7] Sumy National Agrarian University, Ukraine

[8] National Forestry University, Ukraine

[9] Institute of Forest, Environmental and Natural Resource Policy, University of Natural Resources and Life Sciences, BOKU-Vienna, Austria

[10] European Forest Institute (EFI), Forest Policy Research Network, Vienna, Austria

[11] Swiss Federal Institute of Technology (ETH), Switzerland

Abstract

This paper aims to contribute to the conceptual and practical understanding of sustainable transformations in forest landscape governance within a post-war environment, using Ukraine as a case study. By employing a multi-actor approach that integrates the participation of local communities, policymakers, and experts from forestry and agriculture, we propose an innovative tool for fostering discussions and devising strategies to promote sustainable and resilient landscapes. Recognizing the dialogue process as a valuable instrument for disaster risk reduction and conflict resolution, we emphasize the importance of ensuring the inclusion of all relevant stakeholders, particularly local communities, who play a crucial role in shaping the future of their landscapes. Our research findings demonstrate that a sustainable and inclusive landscape governance dialogue, which adopts a holistic perspective by considering the intricate interconnections between the environment, economy, and society, should be firmly rooted in principles of inclusiveness, transparency, and collaboration. By facilitating evidence-based decision-making through comprehensive data gathering and analysis, forest landscape management effectively supports informed discussions among all stakeholders. We believe that modeling human-environmental interaction using a multi-actor approach that integrates people, landscapes, and policy represents an effective means of fostering sustainability in post-war Ukraine. Through the implementation of this comprehensive framework, we can effectively address the complex challenges faced by post-war forest landscapes and promote long-term resilience.

Adaptation of forest management system under the armed conflict in Ukraine

T4.20 Managing Safety and Resilience of Forests and Forestry affected by Armed Conflicts and the Climate Crisis: Past and Future Contribution of Forest Science

Pavlo Kravets[1, 2] , *Oksana Pavlishchuk*[1, 2], *Yevhenii Khan*[1, 2]

[1] National University of Life and Environmental Sciences of Ukraine

[2] FSC Ukraine

Abstract

Armed conflict as no predictable factor of the external environment, necessitated the adaptation of the management system and forestry practices in Ukraine. This adaptation required updating the tools for achieving the goals of responsible forest management. One of the measures for elimination of risk to the health and life of people is excision the areas contaminated by explosive objects (CEO) from the FSC certification scope. Certificate holders shall make relevant changes in forest management and practices in Ukraine if there are CEO areas (which should be reflected in the Annex of the FSC National Forest Stewardship Standard of Ukraine):

- take into account the applicable legislation of Ukraine in terms of hazards associated with explosive hazardous areas;

- outline approaches to the identification of CEO areas, their demarcation, mapping, take into account the best available information and be based on the application of the documented procedure;

- provide for appropriate adaptation of a management plan in terms of all its components (policies, objectives, targets etc.) and adaptation of monitoring system;

- assess, document and monitor impacts related to the CEO areas and ensure an appropriate response to such impacts through adaptive management;

- define the requirements for systematic protection of the CEO areas from unauthorized or illegal resource use and other illegal activities;

- support the legal rights of the affected stakeholders by the presence of CEO areas within a management unit;

- ensure strengthening of management strategies and actions to maintain and/or enhance of High Conservation Values on the territories that are not contaminated with explosive objects;

- prevent forest products from CEO areas from entering FSC supply chains, in particular by implementing appropriate procedures for tracking and tracing of all forest products, as well as procedures for use of FSC name and trademarks.

Incorporating these provisions in the national criteria, indicators and verifiers for excision of CEO areas from the scope of FSC certification will help to preserve the integrity of FSC certification and appropriate adaptation of forest management to the conditions of martial law and post-war situation.