Fire Management today

Volume 77 • No. 1 • 2019

# Global Landscape Fire Challenges: A Decade of Progress


United States Department of Agriculture
Forest Service

# Challenges in Managing Landscape Fires in Eastern Europe

Sergiy Zibtsev and Johann Georg Goldammer

This report from Eastern Europe provides insight into the multifaceted problem of managing fire in the landscapes of Ukraine, a country that is experiencing dramatic changes in its environment and society. Many of the problems highlighted in this paper exemplify the problems that are common in the countries of the region from the shores of the Eastern Baltic Sea down to the Black Sea, including the cultural and natural landscapes of the Baltic States, eastern Germany, Belarus, Poland, and Moldova.

## Regional Context

Climate change, land use change, and the deterioration of the socioeconomic and political situation are main drivers of the worsening wildfire situation in Ukraine. Most importantly, the country faces the challenge of dealing with fires burning in extended areas of forests and other vegetation types that were contaminated by radionuclides after the failure of the Chernobyl Nuclear Power Plant in 1986. The legacy of unexploded ordnance and collateral damages caused by the armed conflict in the southeastern Ukraine region creates additional, nonstandard risks for firefighters.

Eastern Europe is experiencing the consequences of climate change, which already have led to more frequent dry spells and heat waves and the extension of fire seasons. For instance, in the southern part of the country, Ukraine is facing challenging fire weather conditions year round, with an increased risk of uncontrollable large fires. Massive dieback of Scotch pine (*Pinus sylvestris*) has occurred all over the Polessie region (the north of Ukraine from Chernihiv oblast to Volyn).* Here, a ban of sanitary cutting has resulted in a dramatic increase of fuel loads within forests. It is estimated that the combined impacts of climate change, wildfires, and illegal logging have resulted in a loss up to 2 million acres (0.8 million ha) of protected forests and forest belts (windbreak systems) in the southern part of the country. This includes the loss of a substantial part of the Oleshki pine forest in Kherson oblast, which has an important landscape-scale ecological function by preventing desertification and sandstorms in the region.

The economic crisis in the country and the Government cut of financial support for forestry since January 2014, as well as the process of reformation of forestry in Ukraine, have resulted in a sharp reduction of budgets for fire management activities, which state forest enterprises used to generate from their timber sales. As a consequence of reduced state budgets, from 50 to 70 percent of the fire management staff (forest fire station employees, firefighters, and fire observers) had to be released in the southern region of Ukraine (Dnipropetrovsk, Donetsk, Kherson, Kirovograd, Lugansk, Odessa, Mykolaiv, and Zaporizhska oblasts). The forest enterprises in this steppe zone could not compensate for the reduced budgets because they do not generate income from timber sales due to the low quality and

Eastern Europe is experiencing the consequences of climate change, which already have led to more frequent dry spells and heat waves and the extension of fire seasons.

*Sergiy Zibtsev is a professor at the Institute of Forestry and Landscape Park Management, National University of Life and Environmental Sciences of Ukraine, and head of the Regional Eastern Europe Fire Monitoring Center in Kiev, Ukraine. Johann Georg Goldammer is a fire ecologist and director of the Global Fire Monitoring Center, Max Planck Institute for Chemistry and Freiburg University, Freiburg, Germany.*

** "Oblast" is the Ukrainian and Russian term for region, more or less equivalent to a State.*

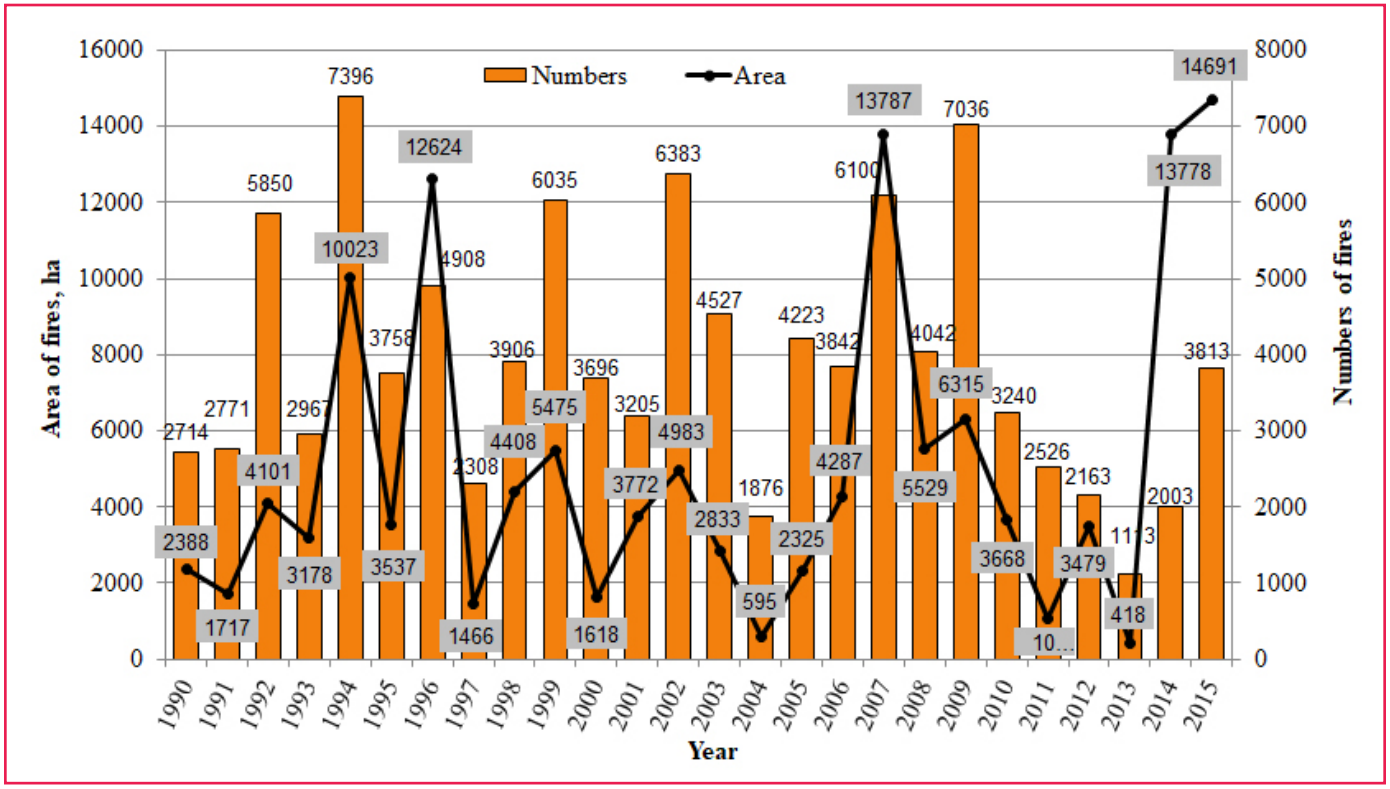


Figure 1—*Number (line) and area of forest fires in Ukraine, 1990–2015. Source: Soshenskyi and others, in press.*

productivity of forests. Thus, these rapid changes in environmental, social, and economic conditions require urgent attention and analysis that could be used for development of a national fire management policy.

## Forest Fires in Ukraine

The total area of forests in Ukraine is about 23.7 million acres (9.6 million ha), covering less than 17 percent of the total land area. The share of coniferous forests is about 42 percent (that is, around 10 million acres (4 million ha)), of which about 33 percent comprises Scotch pine forests. Most forest fires in Ukraine occur in the pine forests in the north of the country (in Polissia) and in the central and southern regions, where forest belts are stocking alluvial sands along the main rivers (Dnipro, Dnister, Yuzgnii Bug, Desna, and Siverskii Donets).

The annual number of forest fires and area burned have been increasing rapidly during the last 25 years. In the 1980s, between 2,000 and 3,000 wildfires were recorded annually; the last decade experienced an increase, with about 7,000 fires on average per year. **Figure 1** shows the wildfire statistics for the period from 1990 to 2015. During this period, the average size of forest fires increased from 0.3 ha in 1990 to 2.6 ha in 2015.

It is highly probable that the actual areas of burned forests are even higher since the national system of fire statistics mainly includes fires reported in forests under management by the State Agency of Forest Resources of Ukraine. Fires that occurred in forests under the jurisdiction of other agencies (27 percent of the total forest area) often were not registered and reported.

Despite the reduced fire management budgets in Ukraine, forests still are better protected from wildfires than are agricultural and other lands, including protected territories. Apart from the current difficult economic situation, forest fire management is relatively well regulated. More than 300 state forest enterprises rely on 270 forest fire stations distributed throughout Ukraine. Fire brigades in the stations are responsible for fire prevention and initial attack in the state enterprises. Wide implementation of video surveillance for fire detection has significantly reduced the time of response and contributed to improved and more effective initial attack.

However, pressing problems in the country include outdated fire engines, often more than 30 years old, and a generally low level of forest firefighter training. The paramount challenge for fire suppression is the lack of trained incident commanders who are able to manage the complex and large fire incidents that have increasingly occurred in recent years.

## Agricultural Burning

Significant land use changes have occurred in Ukraine in recent

decades. From a total of 149.25 million acres (60.4 million ha) of Ukrainian lands that were state owned in 1991, up to 77.6 million acres (31.4 million ha) became private lands and 190,000 acres (77,000 ha) were transferred to collective and communal ownership by 2014. The drastic changes in land use and ownership were not accompanied by new institutional systems that would support the new landowners through appropriate extension services and subsidies. Small landowners are not in a position to protect their lands from fires due to lack of resources and training.

Most importantly, however, the majority of farmers burn agriculture residues instead of plowing or using no-till conservation agricultural methods. As a result, fires on agricultural and other lands in Ukraine have become a regular practice in spring and late summer, resulting in considerable environmental pollution and also becoming the major cause of wildfires spreading to forests and protected areas.

Most farmers burn agriculture residues instead of plowing or using no-till conservation agricultural methods.

One of the regional problems associated with agricultural burning is the emission of so-called black carbon, also called elemental carbon or soot. With the prevailing southerly winds during the burning seasons, the black carbon particles are transported to the Arctic environment. The black carbon deposits reduce the albedo and accelerate the melting of ice and snow (Zibtsev and others 2017).

Within the framework of cooperation between the Regional Eastern Europe Fire Monitoring Center and the Global Fire Monitoring Center (sponsored by the research and development portfolio of the Council of Europe in the implementation of the European Major Hazards Agreement), the spatial and temporal patterns of open burning in Ukraine were studied for the time period 2010–16 (Zibtsev and others 2017). The analysis of satellite data (MODIS sensor) showed that during the investigation period, an average of about 6,500 instances of large-scale agricultural burning were recorded annually, with an apex in 2014 and 2015, when more than 8,000 and

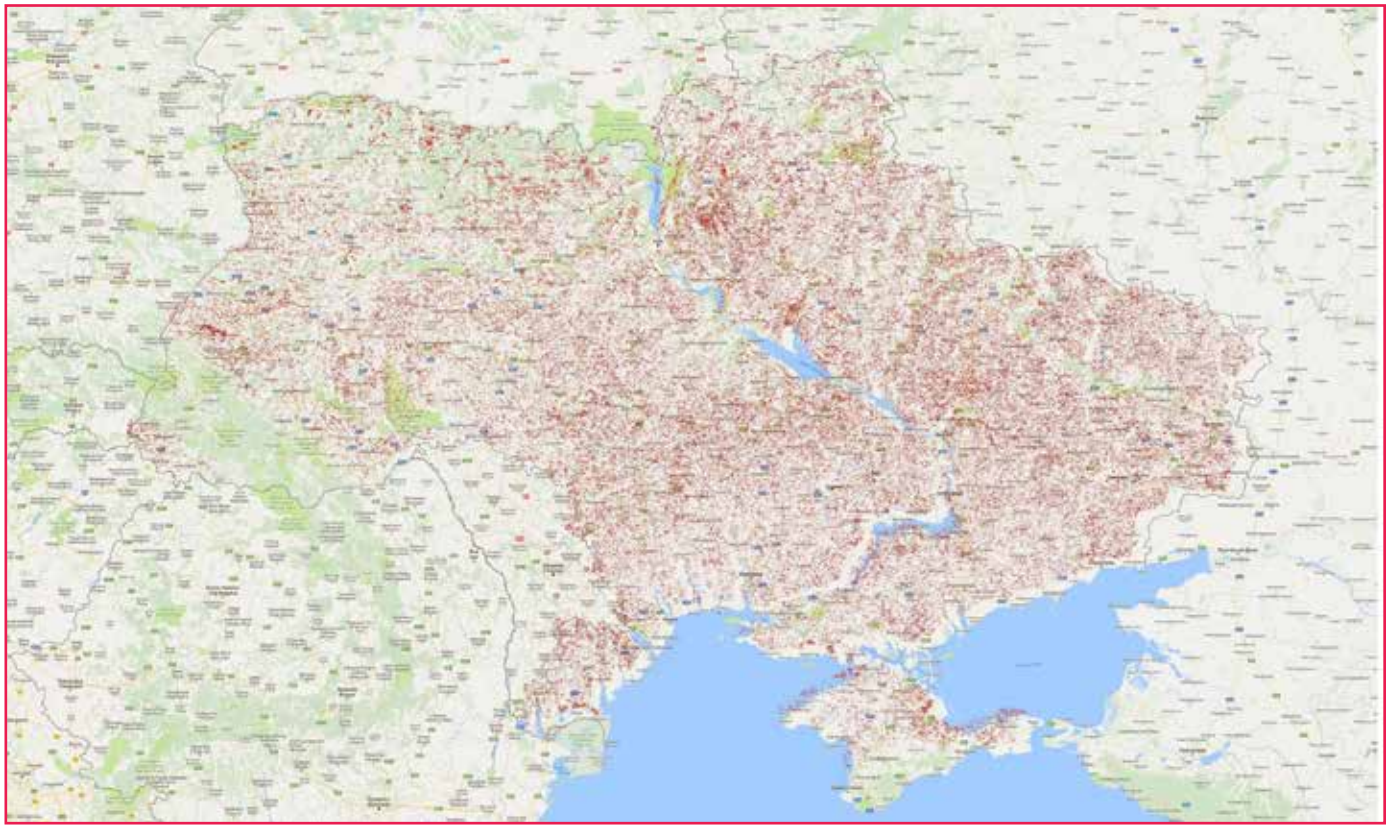

**Figure 2**—*Distribution of open burning activities (red dots) on the territory of Ukraine in 2015. Source: Zibtsev and others (2017).*

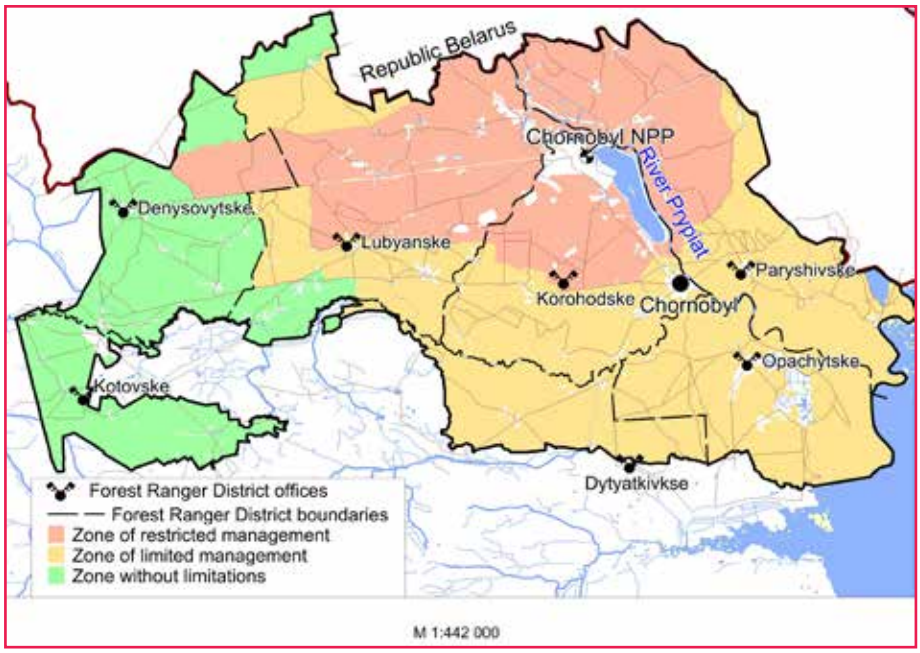


Figure 3—*Locations of the forest ranger district offices in the different contamination areas within the Chernobyl Exclusion Zone. Each district office has a forest fire station. Scale of map: 1:442,000. Source: Zibtsev and others (2015b).*

9,000 fires occurred, respectively. Agricultural burning is practiced primarily in spring (March–April) and after the summer harvest (July–August), mainly in the south of Ukraine (fig. 2).

The total annual area of open burning in Ukraine during the study period varied from a low of 3.16 million acres (1.28 million ha) in 2010 to a high of 13 million acres (5.27 million ha) of agricultural lands burned in 2014 (fig. 2). It needs to be pointed out that extreme drought affected Eastern Europe during the summer of 2010. While the drought created a problematic situation in the European part of Russia, the situation was different in Ukraine. The implementation of an order of the Government of Ukraine on July 31, 2010, resulted in the prevention and swift initial control of agricultural burning, thus reducing the amount of wildfires significantly.

Overall, it must be stated that wildfire threats for rural populations, their assets, and the regional environment increased during the last decade. The amount of rural houses lost to wildfires has increased. Fires affecting protected areas, fire-sensitive landscape types, flood plains, and swamps are negatively affecting the functioning and biodiversity of these ecosystems.

## Fire Management on Terrain Contaminated by Radioactivity

Ukraine and Belarus are the two countries with the largest terrains that were contaminated by radionuclides after the failure of the Chernobyl Nuclear Power Plant in 1986 (Zibtsev and others 2011). In Ukraine alone, over 2.4 million acres (1 million ha) of pine and softwood forests in Chernihiv, Kiev, Zhytomyr, Rivne, and Volyn oblasts were contaminated in the Polissia region along the border with Belarus.

Figure 4—*Left: example of a 35-year-old jack pine (Pinus banksiana Lamb.) stand in the Chernobyl Exclusion Zone (Korogod Forest Ranger District). Right: a 40-year-old Scotch Pine (Pinus sylvestris L.) plantation, also in the zone. Both stands were classified as in fire hazard class I. Photos: Sergiy Zibtsev (August 2014).*

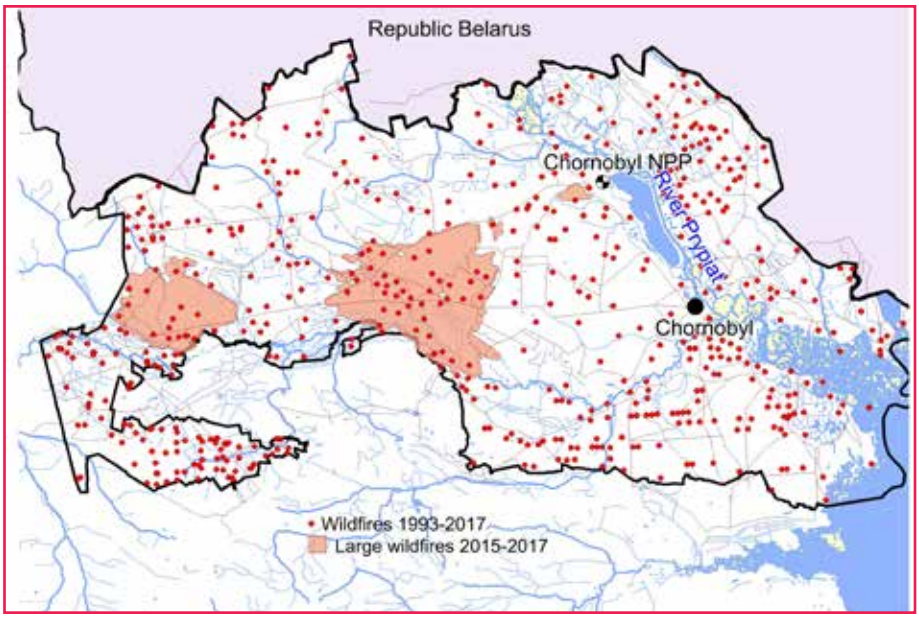


Figure 5—*Spatial distribution of wildfires in the Chernobyl Exclusion Zone from 1993 to 2017, including two large wildfires. The one on the right was in April 2015 (22,800 acres (9,241 ha)), and the on the left was in August 2015 (14,000 acres (5,698 ha)). Source: Regional Eastern Europe Fire Monitoring Center.*

Consequently, a special system of limited forest management was put in place right after the accident based on the level of contamination of the soil and vegetation and the potential doses of radioactivity to which forestry personnel and population would be exposed.

Firefighting in such a contaminated terrain is extremely problematic because personnel are subject to the risk of inhaling additional doses of radionuclides due to the radioactive particles in the smoke and dust released during firefighting.

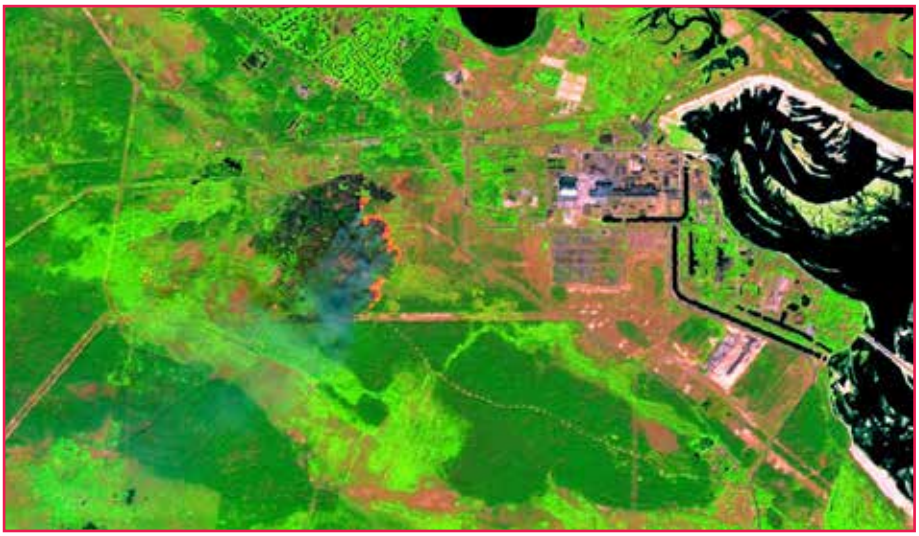

Figure 6—*Wildfire (red and black/gray, center left) burning in the Red Forest area, which has the highest level of radiation in the Chernobyl Exclusion Zone. The fire was 1.9 miles (3 km) west of the failed Reactor No. 4 of the Chernobyl Nuclear Power Plant (the bright area in the upper center right of the satellite imagery shows the newly constructed sarcophagus, which is covering the destroyed Reactor No. 4). The total area burned was 600 acres (250 ha). Source: Copernicus Sentinel, 17 July 2016.*

Since 2014, armed conflict has resulted in significant collateral damage to the natural and cultural landscapes of eastern Ukraine.

Six main types of radionuclides have contaminated the soils and fuels in the environment around the Chernobyl Nuclear Power Plant: Cesium ($^{137}$Cs), strontium ($^{90}$Sr), plutonium ($^{238}$Pu, $^{239-240}$Pu, and $^{241}$Pu), and americium ($^{241}$Am). With half-life periods of up to 24,065 years, these radionuclides release all types of radiation—alpha, beta, and gamma. They are found in all fuel types in contaminated forests, mostly in forest litter, the duff/humus layer, mosses, mushrooms, and the understory vegetation. In grass fires and surface forest fires, most of the radionuclides stay within the inhalation zone of firefighters and are transported by wind and deposited within kilometers around the fire. During large high-intensity fires, vertical convection columns may lift the radionuclides into the higher altitude atmosphere (3 or more miles (5+ km)) and are subjected to long-range transport at regional and even global levels.

After the failure of the Chernobyl Nuclear Power Plant in April 1986, all forest and fire management activities were stopped in the most contaminated terrain, which was designated as the Chernobyl Exclusion Zone (CEZ). Only personnel engaged in the construction of the first concrete-built sarcophagus were allowed to stay. After several large wildfires occurred in the CEZ in 1992, a special forest management

enterprise was reinstalled, with 400 forestry and fire personnel tasked to prevent and fight fires (fig. 3). Although the region enjoyed a period of fire exclusion, major wildfires occurred in 1996, 2003, and 2007. During this period, ecosystems in the CEZ became more and more fire prone due to increasing fuel loads in unmanaged forests and grasslands. The level of the fire hazard on forest lands in the CEZ has been classified, with radioactive contamination taken into account. In particular, the highest hazard class (hazard class I) includes all conifer forests less than 40 years old, all conifers on dry and sandy soils, sites affected previously by fires, clearcuts, grasslands, and all sites with contamination levels higher than 55,500 Bq $m^{-2}$ (fig. 4). The forest fire brigades in the CEZ are very good in responding to small wildfires burning under moderate weather conditions. Each of the six forest fire stations in the CEZ has two to four fire engines and between three and five firefighters; each is responsible for initial suppression on areas up to 99,000 acres (40,000 ha).

The intensity and size of wildfires that affected the CEZ from 2015 to 2017 are due to growing fuel loads and fire hazards, mitigated by effective early response (figs. 5 and 6). However, the management of large fires in 2015–17 revealed weaknesses in preparedness for and response to large/high-complexity fires.

## Wildfires and Armed Conflicts

Apart from the problems associated with the nuclear accident of 1986, Ukraine is currently confronted with the consequences of the armed conflict in Donbas. Donbas is an old cultural landscape that has been subject to intensive land use for centuries. The fertile black soils of the former natural steppe ecosystems are productive agricultural lands.

**Figure 7**—*Uncontrolled burning of the steppe (top) and postfire dieback of a pine stand in the Cretaceous Flora Reserve (bottom). Photos: Sergey Limanskij.*

The main types of forest include mixed oak–maple–ash forests on rich but eroded black soils, extended pine forests growing on sandy soils along the river Siversky Donets, and forests on river delta governed by poplars, willows, and hardwoods. The total area of forests in Donetsk and Lugansk oblasts is 786,780 acres (318,400 ha). More than 80 percent of the forested area is planted forest stands, which are protected and managed to perform exclusively environmental and recreational functions. In addition, there are special protected territories in the region: the Lugansk Nature Reserve, Khomutovskaya Steppe Nature Reserve, Ukrainian Steppe Nature Reserve, and Meotida National Park.

Since 2014, armed conflict has resulted in significant collateral damage to the natural and cultural landscapes of eastern Ukraine. Wildfires also damaged the industrial and social infrastructure and thus contributed to the worsening economic situation and security in the region. Apart from damages to agricultural lands and burned forests, some settlements and critical infrastructure (the electricity grid) have been destroyed by conflict-related wildfires. Additional factors contributing to the situation included the cessation of regular activities to

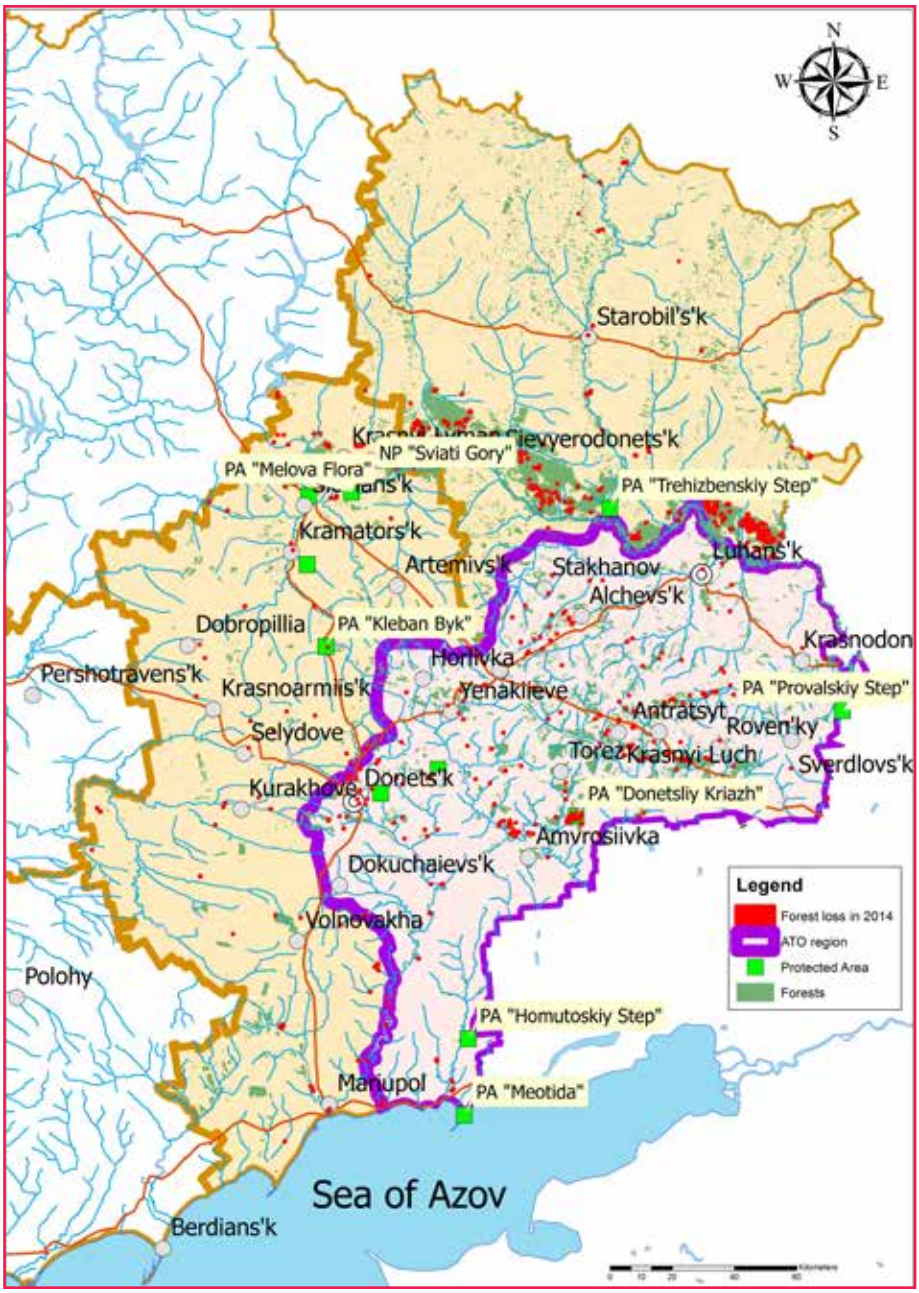


Figure 8—*The locations of wildfires, protected areas, and forests in the conflict zone in eastern Ukraine. (The ATO region is contested, as are areas throughout the conflict zone.) Source: Zibtsev and others (2015a).*

maintain residential and industrial infrastructure and the protection of ecosystems, continuing military operations, and the resettlement of more than 1.5 million citizens from the region (Zibtsev and others 2015a).

Some protected areas bordering on conflict territory have been severely affected by the armed conflict: the Trekhizbenskaya Steppe Reserve, Pridontsovskaya Delta Reserve, Cretaceous Flora Reserve, Preserve "Stone Graves," National Park Svyatiye Gory, Natural Reserves Donetsk Ridge, Zuevsky, and Kleban-Bik (fig. 7). Military operations have even led to significant changes in protected areas remote from the conflict zone, such as the Kremen forests, Kramatorskiy Preserve, and others.

Fire management activities in the regions with active military fighting were halted due to the risk to the lives and safety of forest fire personnel, both from direct attack and from unexploded ordnance. Exploding land mines were the main cause of wildfires in Scotch pine stands in Donbas. Fire suppression operations were not carried out in zones at risk from shelling. In most cases, wildfires continued to burn until they were halted by natural breaks.

According to the Luhansk Forest Amelioration Station (Zyatkov 2018), fires in the conflict zones have already destroyed at least 49,400 acres (20,000 ha) of pine forests, equivalent to about 22 percent of all pine forests in the region. A total of 4,867 wildfires were recorded in the conflict zone by satellite sensors during military operations. Seasonal dynamics of fires correlate well with combat operations, in particular near Ilovaisk city in August 2014 (fig. 8).

Protection of forests from fires in a 9-mile (15-km) zone along the line of contact between the sides stopped shortly after the outbreak of the conflict. The reason was a number of fatalities and injuries of fire management personnel on fire towers caused by snipers and the effects of exploding ordnance on ground firefighters. Furthermore, several fire engines belonging to the forest fire stations were seized by the other side. Often, the military did not allow firetrucks to respond to fires. Since the region is highly fire prone, the halting of fire management activities has led to a significant increase in the number, area, and intensity of fires.

Apart from the direct impacts of fires, the collateral damage caused by the armed conflict has included significant damage to forests. Exploding ordnance has caused widespread damage to the roots, bark,

**Figure 9**—*Contamination of forest litter by unexploded ordnance (left), along with a shell crater (center) and a booby trap (right), exemplifies the threats and damage caused by the armed conflict in the Donbas region. Photos: Sergey Limanskij.*

and crowns of trees, resulting in the weakening and increased mortality of trees and the formation of gaps in the forest canopy and root sponge. The contamination by unexploded ordnance of significant areas constitutes a high threat to the local population (fig. 9), which continues to visit the forests in order to harvest traditional products—mushrooms, berries, and medicinal herbs.

## Sharing Fire Management Solutions Through International Cooperation

In order to benefit from international expertise in fire management in dangerous terrains, the National University of Life and Environmental Sciences of Ukraine contacted the Global Fire Monitoring Center (GFMC) in 2006. At that time, the GFMC was entrusted by the United Nations International Strategy for Disaster Reduction, the Council of Europe, and the Organization for Security and Cooperation in Europe (OSCE) with assisting countries in Southeast and Eastern Europe and the South Caucasus in developing fire management concepts in regions affected by armed conflicts, especially in terrains contaminated by unexploded ordnance and other contaminants (Goldammer 2013a).

In 2007, the Council of Europe and the OSCE supported the organization of the first conference on Reducing Risk of Disaster from Catastrophic Wildfires in the Chernobyl Irradiated Forests, held in Kiev, Ukraine. The conference was followed by an event called Advanced Seminar—Wildfires and Human Security: Fire Management on Terrain Contaminated by Radioactivity, Unexploded Ordnance (UXO) and Land Mines, held in Kiev and Chernobyl in 2009.

Following the recommendations of experts in these meetings, the Council of Europe, through its European Major Hazards Agreement, and the GFMC provided financial and technical support to the National University of Life and Environmental Sciences of Ukraine to set up the Regional Eastern Europe Fire Monitoring Center (REEFMC). Since its establishment in 2013, the REEFMC has been supported by and has cooperated with a number of academic and specialized institutions. Apart from the continuing cooperation with and support of the GFMC and the

European countries are actively exchanging expertise in fire management.

**Figure 10**—*Sand table exercise for Chernobyl firefighters, conducted jointly by fire specialists from the U.S. Forest Service and the Ukrainian fire response teams. Photo: Regional Eastern Europe Fire Monitoring Center.*

Most important is the creation of interoperability between countries that share common problems along their national boundaries.

Global Institute of Sustainable Forestry at Yale University, the REEFMC is currently working with the Global Environment Facility and United Nations Environment Programme within the framework of the project Conserving, Enhancing and Managing Carbon Stocks and Biodiversity in the Chernobyl Exclusion Zone and the OSCE project Improving Radiological and Environmental Awareness in Territories Affected by the Chernobyl Accident in Belarus and Ukraine, with a focus on wildfire management. The OSCE project provided a set of guidelines and best practices for fire management in contaminated terrain, which was applied in May 2018 in the first bilateral exercise on cross-boundary cooperation in wildfire emergency response between Ukraine and Belarus (Goldammer and others 2014, 2016a).

After several large wildfires in the CEZ in 2015, a project funded by the U.S. Department of Agriculture Forest Service and the U.S. Department of State, with the support of the U.S. Embassy in Ukraine, was initiated in 2016. The project, operational from 2016 to 2018 and built on previous activities since 2005, aimed to increase the capacity and safety of fire management in the CEZ. It included facilitating an interagency dialogue with the aim of determining urgent mid- to long-term actions/needs for reducing the risk of catastrophic, uncontrollable fires in the CEZ and increasing the safety of firefighters engaged in suppression. A total of 431 Ukrainian specialists in fire management in the CEZ participated in the project meetings and training sessions during the past 16 months of project activity (fig. 10).

At the policy level, Ukraine is supported by the Council of Europe through the European Major Hazards Agreement—the so-called European Open Partial Agreement

Figure 11—*The first joint tabletop exercise by Ukrainian and Belarussian agencies responsible for fire management and emergency situations was conducted in Gomel, Belarus, under the auspices and sponsorship of the Organization for Security and Cooperation in Europe. Incident commanders from Belarus (left) and Ukraine (right) were supported by a team of moderators (middle, blue vests), administrators (red), and observers/rapporteurs (yellow). Photos: Organization for Security and Cooperation in Europe; Evgeniy Maloletka.*

Figure 12—*Prescribed fires and wildfires in Brandenburg State (Germany) on terrain contaminated by unexploded ordnance are safely controlled by armored firefighting engines. The SPOT–55 is a converted former T–55 combat tank with high-pressure firefighting equipment and a volume of 11 tons of water or other fire suppressants. Photos: Global Fire Monitoring Center.*

(EUR-OPA), to which Ukraine is a party—and the GFMC, a mandated specialized center and coordinator of the Eurasian Team of Specialists on Landscape Fire Management serving the implementation of EUR-OPA. In light of the still unresolved problems of fire management in areas affected by radioactivity, agricultural burning, and climate change, the REEFMC and GFMC convened the first National Round Table on Fire Management under the title Fires in the Natural and Cultural Landscapes of Ukraine: Towards the Development of a National Fire Management Policy. The outcomes of the roundtable, held in Kiev in October 2017, include a statement on the need for developing legal and administrative regulations as well as law enforcement to address the complex problems of fire use and wildfires in the natural, cultural, and industrial landscapes of Ukraine.

## Regional Exchange I: Fire Management in Contaminated Terrain

European countries are actively exchanging expertise in fire management. While the Euro-Mediterranean countries have a strong focus on wildfire suppression, the countries of the temperate zones of Western-Central and Northern Europe prioritize a fire prevention agenda and the use of prescribed fire for wildfire hazard reduction and conservation. These themes, based on several years of cooperation among the GFMC, Ukraine, and Poland, were presented at the Regional Consultation on Cross-boundary Cooperation in Fire Management, which was held in tandem with Ukraine's National Round Table in October 2017.

Most important is the creation of interoperability between countries that share common problems along their national boundaries, such

Figure 13—*A former BMP OTR–5 command tank is used for safe ignition of prescribed fires on terrain contaminated by unexploded ordnance. The ignition devices include a Pyroshot Green Dragon and a driptorch from an all-terrain vehicle. Photos: Global Fire Monitoring Center.*

Figure 14—*Fire triggers explosions of munitions mainly during the summer months, after metal containers of unexploded ordnance are preheated by high temperatures and solar radiation. During burns in winter, the most suitable time of the year from the perspective of conservation and fireline safety, the munitions are cold or frozen due to ambient temperatures and are exposed to view without exploding. Photos: Global Fire Monitoring Center.*

as the radioactively contaminated terrain on the territories of Ukraine and Belarus. On May 17–18, 2018, the OSCE, together with the REEFMC and GFMC, conducted a tabletop exercise with agencies responsible for fire management in the contaminated border regions of the two countries. The main aim was to define capabilities and gaps of interoperability in fire management cooperation across borders. The exercise resulted in valuable insights and conclusions for effective and safe cooperation in addressing the nonstandard wildfire threats in the future (fig. 11).

Some of the technologies and methods that are applied in Germany include the use of armored vehicles for setting prescribed fires and for safe wildfire suppression on terrain with unexploded ordnance. The ordnance, which stems from military action during World War II and from former military shooting ranges, is putting firefighters at extreme risk (Goldammer and others 2016b) (figs. 12–14). Apart from the use of unmanned aerial systems, these techniques offer safe tools for managing fires on terrain contaminated by radioactivity, chemical residues, or deposits of asbestos.

## Regional Exchange II: Use of Fire in Wildfire Prevention and Suppression

In Ukraine—as in other Eastern European countries—the objectives and experiences in the use of prescribed fire for wildfire hazard reduction and wildfire suppression were largely unknown. Starting in 2014, the REEFMC and GFMC organized training sessions for practitioners in the use of prescribed fire for wildfire hazard reduction

Figure 15—*Using prescribed fires for wildfire hazard reduction in pine plantations (left) and in suppression firing (backfiring, right) under the guidance of the Global Fire Monitoring Center on open grasslands in the Boyarska Forest Experimental Station and Ukrainian Center of Advanced Training of Forestry Professionals within the framework of the 6th International Fire Management Week in Ukraine (2015). Photos: Regional Eastern Europe Fire Monitoring Center.*

**Figure 16**—*Prescribed conservation burn for the maintenance and rehabilitation of* Calluna vulgaris *heathlands in Zschorno Forest, a former military exercise area in Brandenburg State, eastern Germany. Located near the border with Poland, the area was converted to a nature reserve in 2002. From 2001 to 2015, significant advances were made in the practical application of fire as a tool for regenerating species endangered by overaging and ecological succession as a consequence of decreased disturbances such as grazing and mowing and of fires caused by former military activities (Goldammer and others 2016b). Photos: Global Fire Monitoring Center.*

inside of pine stands (fig. 15), a practice that is receiving increasing interest for application in Eastern Europe and Russia (Goldammer 2013b).

In the training of suppression firing (the European term for backfiring), the EuroFire Competency Standards are applied in Ukraine (fig. 15) (GFMC 2006). This kind of training will be the core activity of the Eastern European Fire Management Training and Research Center, which was established in late 2018 near Kiev at the Boyarska Forest Experimental Station and Ukrainian Center of Advanced Training of Forestry Professionals, National University of Life and Environmental Sciences of Ukraine, and managed by the REEFMC.

## Regional Exchange III: Use of Prescribed Fire in Conservation

In Western and Central Europe, the use of fire in land management is an established tradition and practice. The region has witnessed centuries of burning, which has contributed to shaping landscape patterns of high ecological and cultural diversity and value, such as heathlands, open grasslands, and meadows. The rapid socioeconomic changes in the past 4 decades and the recently increasing trend of rural exodus all over Eurasia, however, have resulted in abandonment of traditional land use methods and, in many areas, a complete abandonment of land cultivation. With the elimination of disturbance by cultivation, including traditional burning practices, some areas of Europe are converting to fallow lands, a process that is associated with ecological succession towards brush cover and forest and an overall loss of open habitats and biodiversity.

Changing paradigms in ecology and nature conservation have led to reconsideration of fire exclusion policies in certain sectors of land/landscape management, nature conservation, and forestry. In 2008, the GFMC organized a first major

Figure 17—*In 2015, the Global Fire Monitoring Center supported the Forest Fire Protection Laboratory, Forest Research Institute of Poland, and the Ministry of Interior of Poland in conducting the country's first prescribed burning experiment. This demonstration pilot resulted in a change to Poland's legal provisions to allow the use of prescribed fire in conservation. The Polish fire team (left) was supported by an unmanned aerial vehicle, which provided real-time imagery on the progress of the fire (right)—a technology that is becoming common for fire monitoring and rescue operations all over Europe (Szczygiel and others 2016). Photos: Forest Research Institute of Poland; Global Fire Monitoring Center.*

regional conference under the title Symposium on Fire Management in Cultural and Natural Landscapes, Nature Conservation and Forestry in Temperate-Boreal Eurasia. This event allowed scientists and fire managers from Central and Eastern Europe and from Central Asia to exchange scientific knowledge and pragmatic management experiences on the use of prescribed fire in conservation and land management. Consent was reached to release the White Paper on Use of Prescribed Fire in Land Management, Nature Conservation and Forestry in Temperate-Boreal Eurasia, which challenged the agencies concerned to reconsider the prohibition of fire use in land management in most of the European countries (Goldammer 2009). Over the last 10 years, the exchange of expertise between scientists and fire managers in temperate–boreal Eurasia has made remarkable progress, particularly in the restoration and maintenance of open-land ecosystems such as the high-conservation value *Calluna vulgaris* heathlands (figs. 16, 17).

## Final Remarks

It is the intent of the authors of this report to shed light on the ensemble of landscape-scale fire problems in Eastern Europe, which are globally unprecedented. The example of Ukraine shows that the occurrence and consequences of fire use and wildfires in this region are affected by the interaction and mutual reinforcement of multiple factors:

- Social and political changes affecting land use,
- Threats caused by the most serious nuclear accident in the history of humanity, and
- Collateral damages caused by a lasting armed conflict and the increasing consequences of climate change.

## References


Evangeliou, N.; Zibtsev, S.; Myroniuk, V. [and others]. 2016. Resuspension and atmospheric transport of radionuclides due to wildfires near the Chernobyl Nuclear Power Plant in 2015: an impact assessment. Scientific Reports. 6: 26062–26075.

GFMC (Global Fire Monitoring Center). 2006. EuroFire. http://www.euro-fire.eu/. (18 December 2017).

Goldammer, J.G., ed. 2009. White paper on use of prescribed fire in land management, nature conservation and forestry in temperate-boreal Eurasia. International Forest Fire News. 38: 133–152.

Goldammer, J.G. 2013a. Beyond climate change: wildland fires and human security in cultural landscapes in transition—examples from temperate-boreal Eurasia. In: Goldammer, J.G., ed. Vegetation fires and global change: challenges for concerted international action. A White Paper directed to the United Nations and International Organizations. Remagen-Oberwinter, Germany: Kessel Publishing House: 285–311. Chapter 22.

Goldammer, J.G., ed. 2013b. Prescribed burning in Russia and neighbouring temperate-boreal Eurasia. Remagen-Oberwinter, Germany: Kessel Publishing House. 326 p.

Goldammer, J.G.; Kashparov, V.; Zibtsev, S.; Robinson, S. 2014. Best practices and recommendations for wildfire suppression in contaminated areas, with focus on radioactive terrain. Commissioned by the Organization for Security and Cooperation in Europe. Freiburg, Germany; Basel, Switzerland; Kiev, Ukraine: Global Fire Monitoring Center, Ukrainian Institute of Agriculture Radiology, National University of Life and Environmental Sciences of Ukraine, Regional Eastern Europe Fire

Monitoring Center, and Green Cross Switzerland. 53 p. http://gfmc.online/globalnetworks/seeurope/OSCE-GFMC-Report-Fire-Management-Contaminated-Terrain-2014-ENG.pdf (English), http://gfmc.online/globalnetworks/seeurope/OSCE-GFMC-Report-Fire-Management-Contaminated-Terrain-2014-RUS.pdf (Russian). (20 January 2018).

Goldammer, J.G.; Gumeniuk, V.; Kashparov, V. [and others]. 2016a. Ukrainian-Belarusian Guidelines on Fire Management in Contaminated Terrain. Vienna, Austria; Kiev, Ukraine: Organization for Security and Cooperation in Europe. 70 p. http://gfmc.online/wp-content/uploads/BEL-RUS-Chernobyl-Fire-Management-Guidelines-OSCE-GFMC-2017.pdf (Ukrainian and Russian). (20 January 2018).

Goldammer, J.G.; Brunn, E.; Hartig, S. [and others]. 2016b. Development of technologies and methods for the application of prescribed fire for the management of *Calluna vulgaris* heathlands contaminated by unexploded ordnance (UXO): problems and first experiences gained in a research and development project in Germany. Naturschutz und Biologische Vielfalt. 152: 87–122. DOI: 10.19213/973152.

Soshenskyi, O.M.; Zibtsev, S.V.; Gumeniyk, V.V.; Koren, V.A. [In press]. Occurrence of forest fires in Ukraine during 1990-2016. Scientific Bulletin of the National University of Life and Environmental Sciences of Ukraine.

Szczygiel, R.; Goldammer, J.G.; Kwiatkowski, M. [and others]. 2016. Experimental application of prescribed fire for the management of *Calluna vulgaris* heathlands on abandoned military terrain in Poland. Naturschutz und Biologische Vielfalt. 152: 123–140. DOI: 10.19213/973152.

Zibtsev, S.; Oliver, C.; Goldammer, J.G. [and others]. 2011. Wildfires risk reduction from forests contaminated by radionuclides: a case study of the Chernobyl Nuclear Power Plant Exclusion Zone. 5th International Wildland Fire Conference, May 9–13, Sun City, South Africa.

Zibtsev, S.; Zagorodniuk, I.; Averin, D.; [and others]. 2015a. Environmental threats of the conflict in the eastern Ukraine. 26 p. Unpublished document. On file with: ENVSEC Initiative, OSCE Secretariat, Vienna, Austria.

Zibtsev, S.; Goldammer, J.G.; Robinson, S.; Borsuk, O. 2015b. Fires in nuclear forests: silent threats to the environment and human security. Unasylva. 66(243/244): 40–51.

Zibtsev, S.; Goldammer, J.G.; V. Myroniuk, R. [and others]. 2017. Report on assessment of open burning and its environmental impact in Ukraine. 12 p. Unpublished document. On file with: Council of Europe, Strasbourg, France.

Zyatkov, L. 2016. Personal communication. Head of Luhansk Forest Amelioration Station, Luhansk, Ukraine.