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# REVISING FIRE HAZARD RATING METHODS FOR FOREST STANDS IN UKRAINE ON THE EXAMPLE OF OVRUCH SPECIALIZED FOREST ENTERPRISE

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## Abstract

Forest fires play an important role in the deterioration of forests. In 2020, in Zhytomyr region, 28,300 ha of forests were damaged by fire, including about 15,000 ha in Ovruch Specialized Forest Enterprise. Forest fire occurrence depends on forest site conditions, age and type of stands (coniferous or deciduous), and humidity index. However, the significance of neighbouring subcompartments for fire spread has been proved. The number and area of such subcompartments increase after bark beetles' outbreaks or windstorms. The aim of this research was to evaluate the change in the class of fire hazard in Ovruch Specialized Forest Enterprise forests by baseline approach and considering the type of neighbouring subcompartments using GIS technologies. Considering the categories of lands of neighbouring subcompartments shows that for 2010–2018 the class of fire hazard decreased, i.e. the hazard has increased. The area of 1st class stands in 2018 is 3577.5 ha more in the approach of considering the neighbouring subcompartments compared to the baseline approach. Fire hazard in 2018 increased due to a 3063.6 ha increase in the area of subcompartments, which bordered with clear-cuts and unclosed plantations. The effectiveness of predicting the fire occurrence was confirmed by analysing data on the fire spread in 2020. Therefore, this approach is advisable to be widely implemented by the State Agency of Forest Resources of Ukraine to determine the list of forest compartments with a high risk of fire, to evaluate their area, to calculate the location of IP cameras, as well as for navigation and calculation of the optimal path for fire suppression.

**Key words:** clear-cut, GIS, land category, subcompartments.

## Introduction

Lately, thousands of hectares of forests in different parts of the world have been damaged by fire (Alonso-Betanzos et al. 2003, Halofsky et al. 2020, Phelps and Woolford 2021, Woolford et al. 2021). In Polissya, due to climate change and frequent droughts, the frequency and intensity of fires have also increased. For example, in 2010, Zhytomyr region (Forest natural zone) had 1.17 Mha of forest over 39 % of its land area. In 2020, it lost 28,300 ha of forest (Forest Monitoring … 2021). In particular, in Ovruch Specialized Forest Enterprise, fires damaged about 15,000 ha of forested area.

One of the reasons for the increase in the frequency and area of fires is global climate change, an increase in the periods with low precipitations and high temperatures (Goldammer et al. 2013). Another reason is the increase of forest decline by various causes, including outbreaks of bark beetles (Andreieva and Goychuk 2018; Meshkova 2019, 2021). Such areas accumulate a lot of combustible materials. For example, the direct cause of 2020 fire in Zhytomyr region was the burning of stubble in the fields, and the widespread fire was facilitated by the increase in treeless areas in the middle of forests, formed as a result of sanitary felling in the foci of bark beetles. These foci developed in the region in the last decade after the years of drought (Andreieva and Goychuk 2018, Andreieva et al. 2018).

The high costs and complications of fire-fighting necessitate improving the system for fire risk prediction. In different countries, many models have been developed that predict the risk of a fire spread (Kitzberger et al. 2012, Sakellariou et al. 2017, Naderpour et al. 2021). At the same time, data from satellite imagery, information about weather, placement of combustible materials, terrain, composition of a forest stand, etc. are used (Viedma et al. 2009, Maillard et al. 2020). Despite this, fires continue to cover large areas (Forest Monitoring … 2021).

In Ukraine predicting forest fire includes its monitoring based on the data of forest inventory when all forest subcompartments are classified into five hazard classes with the highest being the 1st class (Rules … 2005). A scale for assessing the natural fire hazard of forest lands takes into account three main features: type of stands (coniferous or deciduous), humidity index, and age of stands. Therefore, the database of forest subcompartments includes special field which characterizes the class of fire hazard assessed considering these features.

However, the class of fire hazard of certain subcompartments depends also on their location relative to neighbouring subcompartments (Polupan et al. 2010). Hence, on the border with fresh clear-cut, suddenly lightened trees are weakened (Parkins et al. 2018, Meshkova 2019, Maillard et al. 2020), attacked by pests (Meshkova and Borysenko 2017, 2018), dry out, and are easily affected by fire (Viedma et al. 2009).

Therefore, the level of fire hazard may decrease with forest age (Kitzberger et al. 2012) and with the replacement of coniferous forests to deciduous ones (Polupan et al. 2010). However, more often it can increase due to the change of land categories of neighbouring subcompartments, particularly if the forest is replaced by clear-cuts, burnt areas, unclosed plantations, buildings, roads, etc. (Meshkova and Borysenko 2017, 2018).

Data on increased fire hazard in areas neighbouring to certain categories of land (Borysenko 2017), and the use of GIS (Polupan et al. 2010) makes it possible to improve the system for forecasting forest fire occurrence, particularly to determine the list of forest compartments with a high fire hazard, to evaluate their area, to build appropriate thematic maps, to plan necessary measures and to develop the algorithms for optimal mobilization traffic funds in case of forest fires. It assists in planning fire prevention and suppression.

## Materials and Methods

Ovruch Specialized Forest Enterprise is located in the North-East part of Zhytomyr region (51°19′28″ N and 28°48′29″ E) (Fig. 1). It belongs to the zone of Central Polissya with mixed coniferous and deciduous forests. The climate is temperate continental and is characterized by relatively mild winters, warm summers, and significant rainfall (Anonymous 2021).

Database of Production Association 'Ukrderzhlisproekt' (by 2010 and 2018) was analysed. Each section in the database is characterised by a fire hazard class, which was assessed according to the 'Rules of fire safety in the forests of Ukraine' (Rules ... 2005) taking into account the type of target forest management (coniferous or deciduous stands), the humidity index, or hygrotope (Migunova 1993), and the age of stands. There are 5 classes of a fire hazard (CFH): 1 – high, 2 – above average, 3 – average, 4 – below average, and 5 – low.

By the first (baseline) approach for each subcompartment with coniferous stands under the age of 40 CFH = 1. For coniferous stands older than 40 years and for deciduous stands, the humidity index was considered. Coniferous stands obtained CFH = 1 in very dry and dry conditions, CFH = 2 – in fresh conditions, CFH = 3 in moist and damp conditions, CFH = 4 in wet conditions. Deciduous stands obtained CFH = 2 in very dry and dry conditions, CFH = 3 in fresh conditions, CFH = 4 – in moist and damp conditions, CFH = 5 in wet conditions.

By the second approach during the evaluation of CFH for each subcompartment, an adjustment was made to the

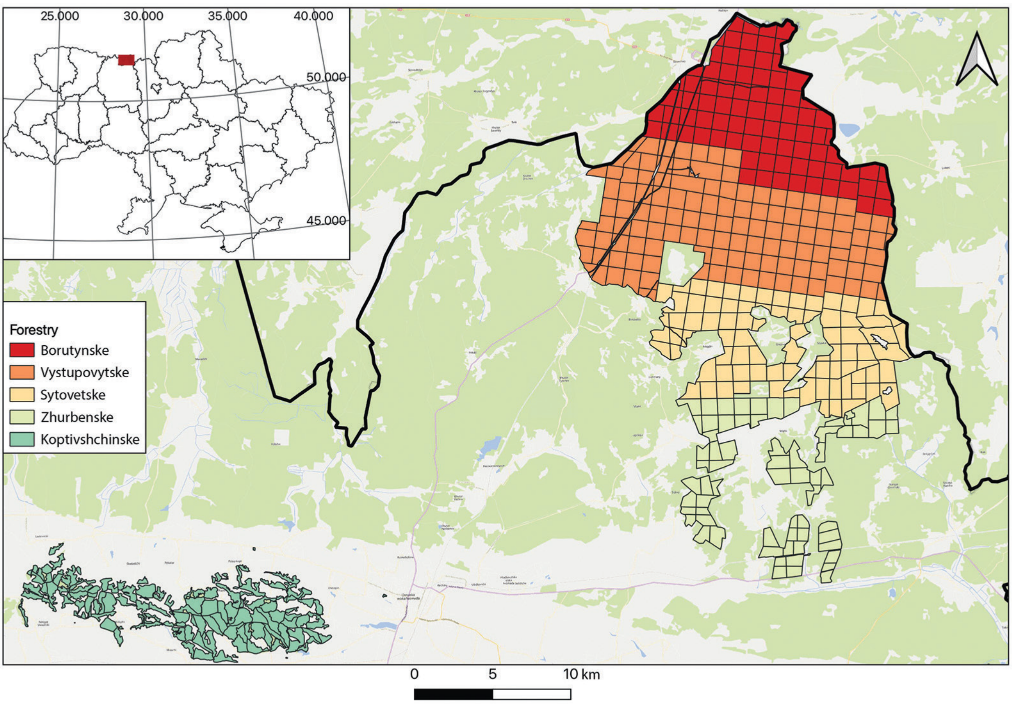


**Fig. 1. Ovruch Specialized Forest Enterprise in the map of Ukraine.**

impact on it of neighbouring subcompartments.

Using QGIS 2.18, the spatial query was formed with the fulfillment of the predicates of neighbourhood, affiliation, and adjoining.

With this said, if the forest plot is bordered with clear-cut of a coniferous stand, then 1 point was added to CFH. In the case of clear-cut of a deciduous stand, the predominant tree species in the neighbouring subcompartment were considered. In the case of predominance of conifers in the neighbouring subcompartment, CFH was taken as 1, and in the case of predominance of deciduous species CFH was taken as 4.

Thematic maps on fire hazard were built using QGIS 2.18 for the whole territory of Ovruch Specialized Forest Enterprise forest fund. Here we show only the maps for Vystupovytske forestry by the variants:

– as of 2010 without considering the land category of neighbouring plots;

– as of 2010 with considering the land category of neighbouring plots;

– as of 2018 without considering the land category of neighbouring plots;

– as of 2018 with considering the land category of neighbouring plots.

The reliability of the suggested approach for predicting the occurrence of a forest fire was assessed in two ways.

In the first method, Sorensen similarity index $C_{sc}$ was used, taking into account the lists of subcompartments by formula (1) where the fire was predicted (*a*) and where it actually occurred (*b*) (Leontyev 2007).

$$C_{sc} = \frac{2c}{a+b}, \qquad (1)$$

where: *a* is the number of subcompartments in which the fire was predicted, *b* is the number of subcompartments in which the fire actually occurred, *c* is the number of subcompartments present in both lists.

Similar calculations were performed using the area of these subcompartments.

In the second method (Atramentova and Utevskaya 2008), tetrachoric correlation coefficient (*r*) and chi-square test ($\chi^2$) were calculated, according to formulas (2) and (3)

$$r = \frac{ad - bc}{\sqrt{(a+b)(c+d)(a+c)(b+d)}}, \qquad (2)$$

where: *a* is the number of subcompartments present in the predicted and actual list of fires, *b* is the number of subcompartments present in the actual and absent in the predicted list of fires, *c* is the number of subcompartments present in the predicted and absent from the actual list of fires, *d* is the number of subcompartments absent from both lists.

$$\chi^2 = n \cdot r^2, \qquad (3)$$

where: $n = (a + b + c + d)$.

The relationship was considered statistically significant if $\chi^2_{observed} > \chi^2_{0.05}$.

Similar calculations were performed using the area of these subcompartments.

In both methods, the predicted indicators were estimated for two options:

– without considering the category of lands of neighbouring subcompartments;

– considering the category of lands of neighbouring subcompartments.

## Results and Discussion

Calculations in accordance with the ‘Rules of fire safety in the forests of Ukraine’ (Rules … 2005) show that Ovruch Specialized Forest Enterprise as of 2010 presents all classes of fire hazard. In general, the 2nd (28.9 %) and the 3rd (28.8 %) ones dominate, with a weighted average CFH = 2.75 (Table 1).

**Table 1. Distribution of forest area of Ovruch Specialized Forest Enterprise by CFH as of 2010 without considering land categories of neighbouring plots.**

| Forestries | Area by fire hazard classes, ha/% | | | | | Total area, ha/% | Weighted average CFH, points |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Sytovetske | 1430.2<br>16.5 | 3126.2<br>36.0 | 2165.3<br>24.9 | 1486.8<br>17.1 | 482.5<br>5.6 | 8691.0<br>100 | 2.59 |
| Borutynske | 1243.0<br>13.8 | 2417.1<br>26.8 | 2272.7<br>25.2 | 2619.4<br>29.0 | 470.8<br>5.2 | 9023.0<br>100 | 2.85 |
| Vystupovytske | 2431.4<br>17.9 | 2743.5<br>20.2 | 3930.7<br>29.0 | 3412.8<br>25.2 | 1031.6<br>7.6 | 13,550.0<br>100 | 2.84 |
| Zhurbenske | 782.3<br>15.3 | 2081.3<br>40.6 | 1226.2<br>23.9 | 766.4<br>15.0 | 268.8<br>5.2 | 5125.0<br>100 | 2.54 |
| Koptivshchinske | 234.9<br>5.0 | 1501.9<br>32.3 | 2212.4<br>47.5 | 518.9<br>11.1 | 187.9<br>4.0 | 4656.0<br>100 | 2.77 |
| Total | 6121.8<br>14.9 | 11,870.0<br>28.9 | 11,807.3<br>28.8 | 8804.3<br>21.5 | 2441.6<br>5.9 | 41,045.0<br>100 | 2.75 |

The lowest value (i.e. the greatest fire hazard) was found for Zhurbenske and Sitovetske (2.54 and 2.59), and the greatest for Vystupovichske and Borutinske forestries (2.84 and 2.85 respectively). At the same time, 2nd class predominates (36 %) in Sytovetske forestry, which is largely due to the terrain features and distribution of stands by type of forest site conditions.

The evaluation of the distribution of forest land area by CFH in all forestries shows that the weighted average in 2010 is less considering the categories of lands of neighbouring subcompartments than without such consideration (tables 1 and 2). The difference of CFH is 0.17 points for the whole Enterprise. The area of the stands of the 1st class of fire hazard is more by 2080.8 ha, including in Sitovtske and Zhurbenske – by 992.1 and 484.5 ha, or 11.9 and 10.2 %, respectively.

The highest fire hazard there is in Zhurbenske (2.32) and Sytovetske (2.33) forestries, where the stands of 1st–3rd classes predominate (Table 2).

**Table 2. Distribution of forest area of Ovruch Specialized Forest Enterprise by CFH as of 2010 considering land categories of neighbouring plots.**

| Forestries | Area by fire hazard classes, ha/% | | | | | Total area, ha/% | Weighted average CFH, points |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Sytovetske | 2422.3<br>28.4 | 2649.5<br>31.1 | 1997.9<br>23.5 | 1136.9<br>13.3 | 313.1<br>3.7 | 8519.7<br>100 | 2.33 |
| Borutynske | 1448.0<br>16.4 | 2366.4<br>26.9 | 2248.2<br>25.5 | 2475.6<br>28.1 | 269.9<br>3.1 | 8808.1<br>100 | 2.74 |
| Vystupovytske | 2764.5<br>20.8 | 2911.5<br>21.9 | 3919.6<br>29.5 | 3058.8<br>23.1 | 613.5<br>4.6 | 13,267.9<br>100.0 | 2.69 |
| Zhurbenske | 1266.8<br>25.5 | 1780.0<br>35.8 | 1150.8<br>23.1 | 598.7<br>12.0 | 175.5<br>3.5 | 4971.8<br>100 | 2.32 |
| Koptivshchinske | 301.0<br>6.5 | 1535.0<br>33.0 | 2146.8<br>46.2 | 508.8<br>10.9 | 155.4<br>3.3 | 4647.0<br>100 | 2.72 |
| Total | 8202.6<br>20.4 | 11,242.4<br>28.0 | 11,463.3<br>28.5 | 7778.8<br>19.3 | 1527.4<br>3.8 | 40,214.5<br>100 | 2.58 |

When calculating data for 2018 without considering the categories of lands of neighbouring subcompartments it can be seen that in general the fire hazard slightly changed (the class of fire hazard increased from 2.75 to 2.77) (Table 3).

When calculating data for 2018 without considering the categories of lands of neighbouring subcompartments, it is clear that the fire hazard has slightly decreased (CFH increased from 2.75 to 2.77) (Table 3). At the same time, the area of the stands of the 1st class in the whole Ovruch Specialized Enterprise increased by 456.3 ha. In Sitovetske and Borutynske forestries, CFH increased (by 0.08 and 0.12 respectively) and in the rest of forestries it decreased (tables 1 and 3).

Analysis of the distribution of forest land area of Ovruch Specialized Forest Enterprise by CFH, considering the categories of lands of neighbouring subcompartments (Table 4) shows that for 2010–2018 CFH decreased in all forestries by 0.01–0.04, i.e. the hazard has increased, for the whole enterprise by 0.04. The area of stands with 1st class increased by 1577.3 ha in the whole Enterprise, most of all in Zhurbenske forestry (by 635 ha). The area of stands of 5th class decreased by 157.3 ha for the whole Enterprise, most of all in Zhurbenske forestry (by 123.4 ha) (tables 2 and 4).

Comparison of data in tables 3 and 4 shows that considering the neighbouring subcompartments, the CFH is less by 0.15, most of all in Zhurbenske (by 0.28), Sitovetske (by 0.23), and Borutynske forestry (by 0.20). This class slightly increased only in Koptivshchinske forestry (by 0.06).

The area of stands of the 1st class increased by 3577.5 ha, including in Sitovetske forestry by 1028.2 ha, and in Zhurbenske forestry by 979.4 ha.

Spatial analysis shows that the fire hazard in 2018 has increased due to an increase in the area of subcompartments, which bordered with clear-cuts and unclosed plantations. This area amounted to 7309.3 ha in 2010 and 10,372.9 ha in 2018, i.e. increased by 3063.6 ha. At the same time, some subcompartments (especially of a large length) bordered with several (from 1 to 9) subcompartments with the named categories of lands (Fig. 2).

**Table 3. Distribution of forest area of Ovruch Specialized Forest Enterprise by CFH as of 2018 without considering land categories of neighbouring plots.**

| Forestries | Area by fire hazard classes, ha/% | | | | | Total area, ha/% | Weighted average CFH, points |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Sytovetske | 1632.8<br>18.7 | 2212.5<br>25.4 | 2615.6<br>30.0 | 1861.7<br>21.4 | 395.6<br>4.5 | 8718.2<br>100 | 2.68 |
| Borutynske | 929.1<br>10.4 | 2159.5<br>24.1 | 2342.8<br>26.1 | 3275.9<br>36.5 | 256.7<br>2.9 | 8964.0<br>100 | 2.97 |
| Vystupovytske | 2374.3<br>17.5 | 2797.2<br>20.7 | 3819.6<br>28.2 | 3758.3<br>27.8 | 782.1<br>5.8 | 13,531.5<br>100.0 | 2.84 |
| Zhurbenske | 1073.1<br>20.8 | 1875.3<br>36.4 | 1151.9<br>22.3 | 883.2<br>17.1 | 171.4<br>3.3 | 5154.9<br>100 | 2.46 |
| Koptivshchinske | 568.8<br>12.6 | 1073.7<br>23.8 | 2203.7<br>48.8 | 510.0<br>11.3 | 161.5<br>3.6 | 4517.7<br>100 | 2.69 |
| Total | 6578.1<br>16.1 | 10,118.2<br>24.7 | 12,133.6<br>29.7 | 10,289.1<br>25.2 | 1767.3<br>4.3 | 40,886.3<br>100 | 2.77 |

**Table 4. Distribution of forest area of Ovruch Forest Enterprise by CFH as of 2018 considering land categories of neighbouring plots.**

| Forestries | Area by fire hazard classes, ha/% | | | | | Total area, ha/% | Weighted average CFH, points |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | | |
| Sytovetske | 2601.7<br>28.4 | 2105.9<br>31.1 | 2304.7<br>23.5 | 1380.7<br>13.3 | 214.3<br>3.7 | 8607.3<br>100.0 | 2.36 |
| Borutynske | 1648.5<br>16.4 | 2119.1<br>26.9 | 2082.6<br>25.5 | 2904.0<br>28.1 | 77.5<br>3.1 | 8831.7<br>100.0 | 2.73 |
| Vystupovytske | 3059.1<br>20.8 | 3003.5<br>21.9 | 3370.4<br>29.5 | 3505.4<br>23.1 | 422.8<br>4.6 | 13,361.2<br>100.0 | 2.64 |
| Zhurbenske | 1901.8<br>25.5 | 1478.6<br>35.8 | 994.1<br>23.1 | 636.2<br>12.0 | 84.5<br>3.5 | 5095.2<br>100.0 | 2.12 |
| Koptivshchinske | 568.8<br>6.5 | 1074.9<br>33.0 | 2203.5<br>46.2 | 512.4<br>10.9 | 116.8<br>3.3 | 4476.4<br>100.0 | 2.67 |
| Total | 9779.9<br>20.4 | 9782.0<br>28.0 | 10,955.3<br>28.5 | 8938.7<br>19.3 | 915.9<br>3.8 | 40,371.8<br>100.0 | 2.54 |

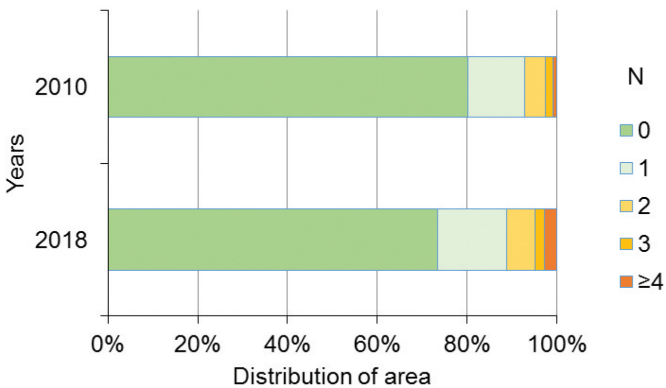


**Fig. 2. Distribution by area of forest stands bordering on plots, the neighbouring of which increases the fire hazard.**

Note: N is number of subcompartments which increase the fire hazard.

Thematic maps on fire hazard for Vystupovytske forestry (Fig. 3) show the predominance of shades of red (CFH in 2018 compared to 2010) and on the right side of the figure (analysis considering neighbouring subcompartments) compared to the left side of the figure (analysis without taking into account neighbouring areas).

So for the period 2010–2018, the average weighted CFH without considering the land categories of neighbouring subcompartments almost did not change. The area of stands of almost all CFH decreased, except for the 2nd, which increased by 54 ha (tables 1 and 3). Taking into account the neighbouring subcompartments in 2010, the weighted average CFH decreased over the analysed period.

The area of stands with the highest risk of fire hazard in 2018 was 3059.1 ha, i.e. was 294.6 ha more than excluding neighbours (tables 2 and 4), and compared to 2018, excluding neighbours (Table 3), it was 684.8 ha higher.

The total area of 1st and 2nd classes in Vystupovytske forestry, excluding neighbouring subcompartments, has changed little over the period 2010–2018 since neither the stand composition nor the hygrotope changed during this time (tables 1 and 3). At the same time, the difference between these values when analysed with regard to neighbouring subcompartments

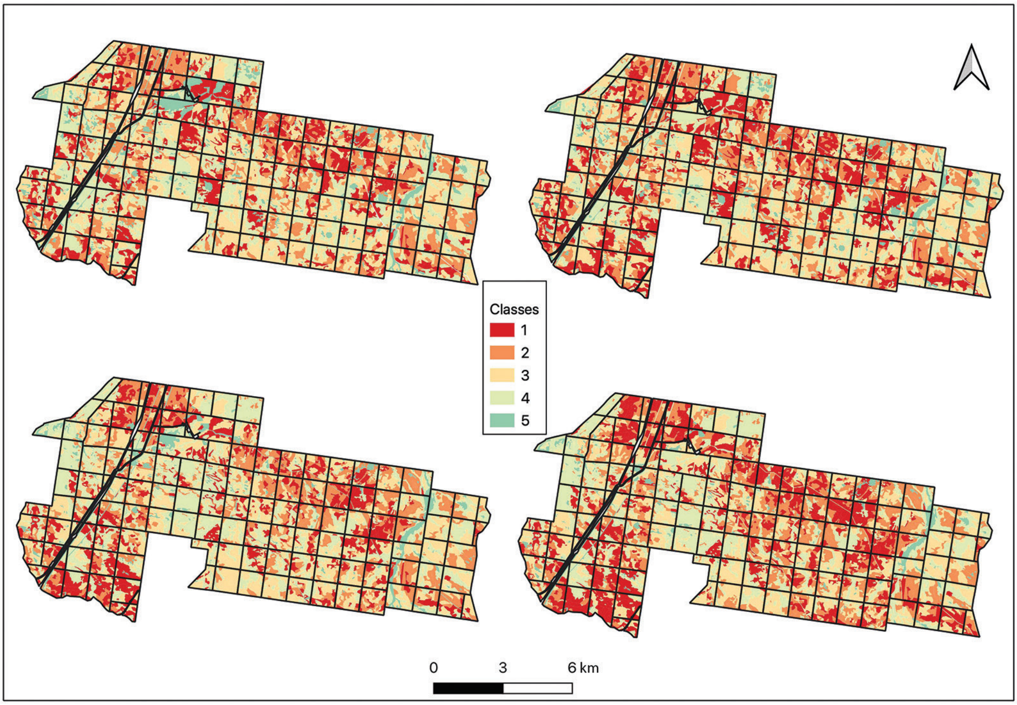


**Fig. 3. Distribution of forest subcompartments of Vystupovytske forestry by CFH.**

Note: upper row – as of 2010, lower row – as of 2018; on the left – CFH defined without considering the land categories of neighbouring subcompartments; on the right – CFH defined with considering the land categories of neighbouring subcompartments.

is 386.6 ha (tables 2 and 4).

The calculation of Sorensen similarity index shows a high coincidence of the predicted list of subcompartments with a fire threat and the actual list of such subcompartments (Table 5).

Also, high values of Sorensen similarity index were obtained when using the area of respective subcompartments in the calculation. Sorensen similarity index, when taking into account the land categories in neighbouring subcompartments, has a greater value (0.85 and 0.86) than without taking them into account (0.76 and 0.75), which confirms the advantages of the suggested approach (Table 5).

The calculation according to the second approach made it possible to obtain significant values of the correlation index $r$ and chi-square test taking into account both the number of subcompartments and their area (Table 6).

The correlation index $r$ when taking into account the land categories in neighbouring subcompartments, has a greater value (0.765 and 0.776) than without taking them into account (0.631 and 0.601). Chi-square test when taking into account the categories of land in neighbouring subcompartments has also greater value than without taking them into account.

Given methodological approach has been earlier tested on the materials of the forest fund of Kreminske Forest and Hunt-

**Table 5. Data for calculation Sorensen similarity index $C_{sc}$ for fire prediction approaches.**

| Parameters | Without considering the land category of neighbouring subcompartments | | Considering the land category of neighbouring subcompartments | |
|---|---|---|---|---|
| | Number of subcompartments | Area, ha | Number of subcompartments | Area, ha |
| Predicted | 6132 | 16,696.3 | 6986 | 19,561.9 |
| Fact | 5208 | 14,720.4 | 5208 | 14,720.4 |
| Common | 4313 | 11,811.1 | 5164 | 14,670.8 |
| $C_{sc}$ | 0.76 | 0.75 | 0.85 | 0.86 |

**Table 6. Calculated data for the correlation index *r* and chi-square test for fire prediction approaches.**

| Set of subcompartments | Without considering the land category of neighbouring subcompartments | | Considering the land category of neighbouring subcompartments | |
|---|---|---|---|---|
| | Number of subcompartments | Area, ha | Number of subcompartments | Area, ha |
| Present in the predicted and actual list of fires | 4313 | 11,811.1 | 5164 | 14,670.8 |
| Present in the predicted and absent from the actual list of fires | 1819 | 4885.2 | 1822 | 4891.1 |
| Present in the actual and absent in the predicted list of fires | 895 | 2909.3 | 44 | 49.6 |
| Absent from both lists | 8587 | 21,280.7 | 7586 | 20,760.3 |
| $r$ | 0.631 | 0.601 | 0.765 | 0.776 |
| $\chi^2$ | 6212.3 | 14,779.6 | 8553.2 | 24,324.8 |

Note: at df > 100 and $p < 0.05$, $r = 0.06$ and $\chi^2 = 124.3$.

ing Enterprise of Luhansk region (Steppe natural zone). The predicted location of subcompartments with a high fire hazard coincided with the actual situation (Borysenko 2017).

Having data for each subcompartment, in this study we were able to assess the reliability of forecasting the list of forest compartments with a high fire hazard and their area using the new approach and compare it with the results of the classical one. The calculation of Sorensen similarity index, correlation index, and chi-square test shows a high coincidence of the predicted list of subcompartments with a fire threat and the actual list of such subcompartments. Suggested approach does not consider fire ignition causes and types, however, it gives the possibility to recognise more exactly compared to baseline approach the list, location, and area of subcompartments vulnerable to fire damage considering the categories of lands of neighbouring subcompartments. The obtained data can be used to calculate the location of IP cameras, as well as for navigation and calculation of the optimal path for fire suppression.

## Conclusions

Taking into account the risk of an increase in a fire hazard in the forest subcompartments bordering with clear-cuts and some other categories of land, where the forest was replaced by treeless areas, an algorithm was applied to determine the amendment to fire hazard classes using a forest inventory database and cartographic materials. The suggested approach makes it possible to identify additional subcompartments of the stands with an increased risk of fire.

The analysis showed that in all forestries of Ovruch Specialized Forest Enterprise for 2010–2018 the class of fire hazard decreased, i.e. the hazard has enhanced. The area of stands of the 1st class in 2018 is 3577.5 ha more in the approach of considering the neighbouring subcompartments, particularly, 3063.6 ha due to an increase in the area of subcompartments, which bordered with clear-cuts and unclosed plantations. The effectiveness of predicting the list of subcompartments vulnerable to fire damage considering the categories of lands of neighbouring subcompartments was confirmed by analysing data on the fire spread in 2020. Therefore, this approach is advisable to be widely implemented by the State Agency of Forest Resources of Ukraine to determine the list of forest compartments with a high risk of fires, to evaluate their area, and to improve fire prevention and suppression.

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