


Rendkívüli időjárási körülményekkel kapcsolatos tűzoltó beavatkozások Bács-Kiskun vármegyében – erdő- és vegetációs tüzesetek

Firefighter Interventions Associated with Extraordinary Weather Conditions in Bács- Kiskun County – Forest and Vegetation Fires

János Gyapjas
author

Bács-Kiskun County Disaster Management Directorate, deputy director

Email: janos.gyapjas@katved.gov.hu

ORCID: 0000-0001-7088-2123 

Absztrakt:

A környezetemben is egyre gyakoribb szélsőséges időjárási jelenségek hatására elhatároztam, hogy megvizsgálom a kapcsolódó tűzoltó beavatkozásokat Bács-Kiskun vármegyében. Az erdő- és vegetációs tüzek témáját választottam elsőként. Nagyon aktuális és jelentős téma, különös tekintettel a vármegye veszélyeztetettségére, illetve az élet- és értékvédelemre. Statisztikai adatok és nagy erdőtüzek elemzésének segítségével azonosítom azok jellemző sajátosságait. Ezeket összesítem és összevetem a korábbi évek fejlesztési mérföldköveivel. Végül konkrét javaslatokat teszek a megelőzés és felkészülés további optimalizálására.

Kulcsszavak: tűzvédelem, erdőtűz, Bács-Kiskun, tapasztalatok, fejlesztés

Abstract:

Due to the increasing frequency of extreme weather phenomena in my environment, I have decided to investigate the firefighting interventions related to them in Bács-Kiskun county. My initial focus is on forest and vegetation fires, a highly relevant and crucial subject, particularly considering the county's risk level and the imperative to protect life and property. Utilizing statistical data and analysis of significant forest fires, I aim to identify their characteristic features. I will then summarize and compare these features with the developmental milestones from previous years. Ultimately, I will provide concrete recommendations for further optimizing prevention and preparedness.

Keywords: fire protection, forest fire, Bács-Kiskun, experiences, development

1. INTRODUCTION

In my work, I dedicate a significant amount of time to forest fire protection. I am a professional firefighter in Bács-Kiskun county, where one of the main hazards is forest fires. In Hungary, there are two counties with a high risk of forest fires, and Bács-Kiskun is one of them [1]. It is the largest county in Hungary, covering 8444.81 km² and divided into 11 districts and 119 municipalities. I consider forest fire protection to be crucial and increasingly relevant. This belief is supported not only by my personal experience but also by literature. Forest fire protection is a comprehensive concept that encompasses fire prevention, firefighting, fire investigation, as well as regulation and cooperation.



Figure 1.: Aqua/MODIS satellite image of the Bugac (Source: [2])

I was personally involved in extinguishing the forest fire in Bugac, which covered about 10 km². The plume of smoke was visible from a distance when I was leaving for the Puszta, and the sight of it remains a defining memory for me. While working on a study of the fire, I came across a publication by the National Meteorological Service and a satellite image. According to this article, the Bugac forest fire on 29 April, 2012 (the day it started) significantly increased air pollution in Budapest. The combined rapid rise in PM₁₀ and CO concentrations made the source clear [3]. The satellite image in Figure 1, combined with my personal experience, is a huge exclamation mark for me: the issue is very important, and we need to deal with it.

Based on my own research, it is established that major, long-lasting, large-scale forest fires occur every 5-7 years in Bács-Kiskun county [4]. To extinguish these fires, forces of at least alert level V/K are required. The alarm level indicates the firefighting power needed to extinguish the fire, with the letter "K" specifying the special vehicle required, such as a water truck or forest fire engine. For level V, more than six firefighting squads (36 persons) must be alerted [11, 37.§ (5)-(6)]. Fires of this magnitude do not occur every day.

Nevertheless, in July 2015 and July 2022, we had to deal with two such fires simultaneously, which made national news [5] [6]. The study by Dr. György Bodnár and Péter Debreceni [7] shows an increasing tendency of forest fires in Hungary for the period 2013-2021.

According to experts from the United Nations Environment Programme, forest fires are expected to increase by 50% by the end of the century, with forest fires and climate change exacerbating each other. They recommend enhancing prevention and preparedness efforts [8].

In line with the European Forest Fire Information System data [9], the area of forest fires in August 2022 exceeded 5000 km² in the European Union, more than double the long-term average. Smoke emissions were also the highest since 2007. Besides several regions of Europe, Hungary also experienced significant forest fire activity [10].

The importance of the risks related to forest fires cannot, in my view, be overemphasized. In a previous study, I have already highlighted the significance of collecting and processing experience [4]. By using and adapting them, the effectiveness of prevention and preparedness can be optimized. In Bács-Kiskun county, we organized national conferences and exercises on this topic in 2013 and 2016 [4].

Due to the impact of extreme weather-generated incidents in recent years, I decided to investigate them in Bács-Kiskun county. First and foremost, I focused on forest and vegetation fires. My research methods primarily involved historical analysis and event analysis. In this comprehensive study, I aimed to:

- Analyze the characteristics of forest and vegetation fires and their geographical distribution using a statistical database covering many years;
- study and collect the main characteristics and features of long-lasting, large-scale forest fires;
- briefly summarise the development features and characteristics previously introduced and applied in our county;
- summarise this information and provide a basis for the assessment and further analysis of forest and vegetation fire risk in the county, and to make recommendations for the continuation of prevention and optimisation of preparedness.

2. CHARACTERISTICS AND TRENDS OF FIRES

2.1 Trends in case numbers

The fire brigades are obliged to collect and provide data on their interventions, the order and content of which are determined by the Director General of the National Directorate General for Disaster Management, Ministry of the Interior (Belügyminisztérium Országos Katasztrófavédelmi Főigazgatóság, BM OKF) [11]. Data is collected through the Disaster Management Data Service Programme (Katasztrófavédelmi Adatszolgáltató Program, KAP-Online) [12]. Previous data collections have been carried out in such different ways and formats that they are extremely difficult to analyze. Therefore, I have not included them in the current research. For this study, I used the KAP-Online database (forest and vegetation fires only), started on 1 January, 2011, and closed on 31 December, 2022, covering a period of 12 years.

Experience has shown that the number of outdoor/forest vegetation fires correlates with the total number of fires. Based on a multi-year average, forest/vegetation fires account for about 19.2% of all fires, which proportionally represents two-thirds of all outdoor fires.

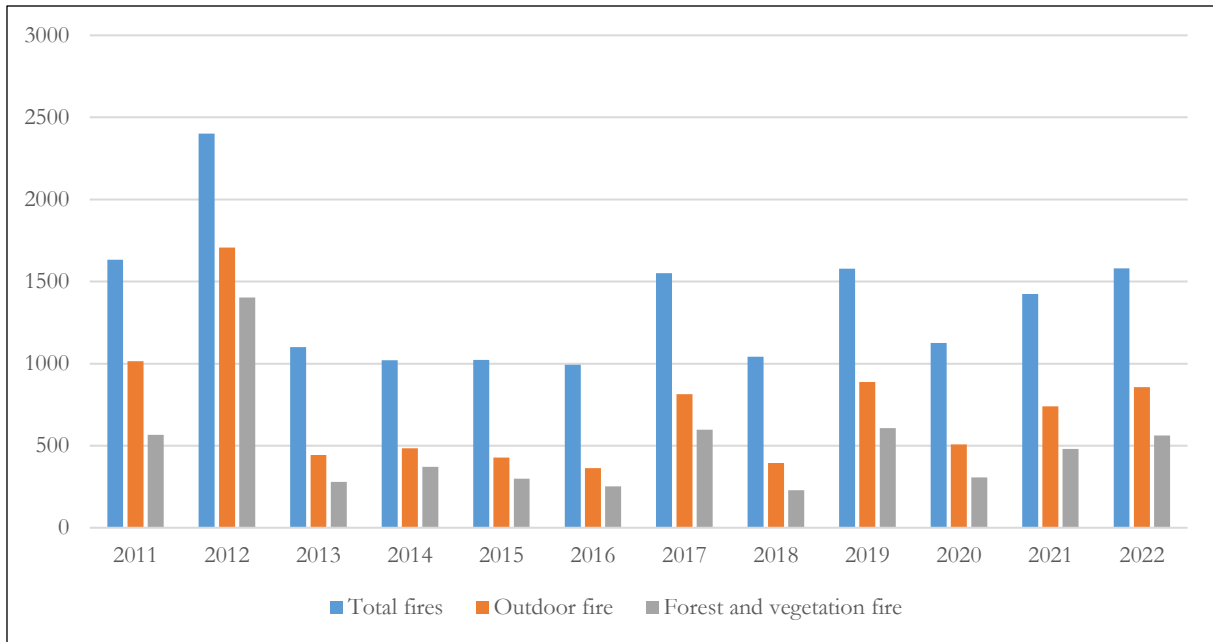


Figure 2.: Trends of fires in Bács-Kiskun county (made by the author)

The average number of forest and vegetation fires per year is 500. Almost half of the period is above average: 2011, 2012, 2017, 2019, and 2022. The 2012 value is almost three times the multi-year average, while the other years are of the same order of magnitude. The 2018 minimum is about half the average. The multi-year trend is upward, especially in the second half of the period.

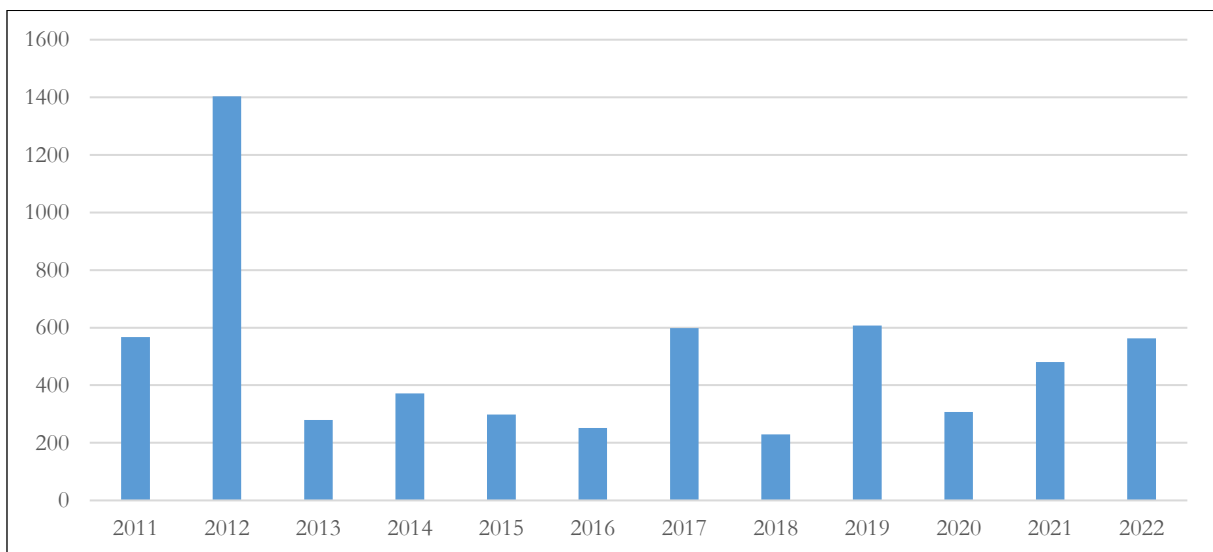


Figure 3.: Number of forest and vegetation fires (made by the author)

For the entire period, the highest number of fires was recorded in the districts of Kiskőrös, Kalocsa, and Kecskemét. In terms of incidents per population, Drágszél, Öregcsertő, and Újsolt stand out. Among the top 15 settlements, 12 (underlined> are located in Kalocsai or Kiskőrösi districts: 1. Drágszél, 2. Öregcsertő, 3. Újsolt, 4. Tabdi, 5. Homokméggy, 6. Csengőd, 7. Bácsszentgyörgy, 8. Szakmár, 9. Balotaszállás, 10. Akasztó, 11. Páhi, 12. Miske, 13. Kiskőrös, 14. Dunatetőtlen, 15. Bugacpusztaháza.

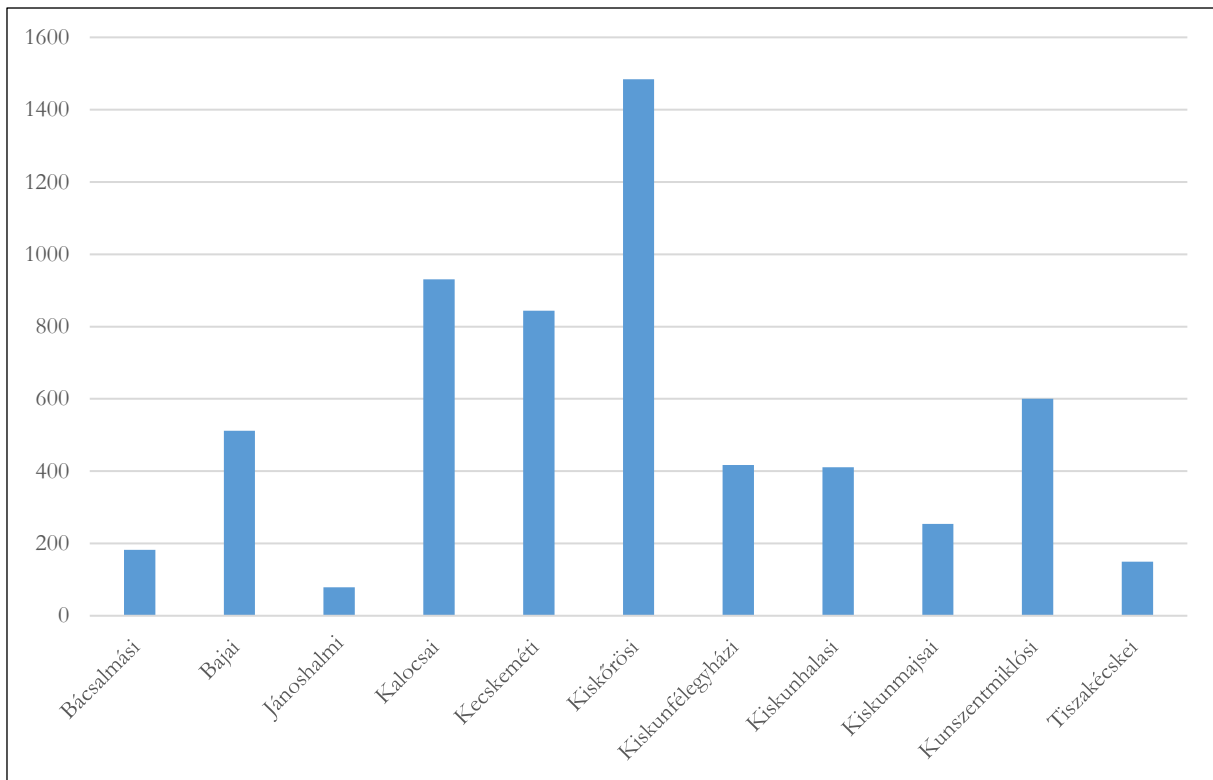


Figure 4.: Case numbers by district for the whole period (made by the author)

2.2 Evolution of alert levels

The forces required to extinguish fires are expressed in terms of the degree of alert, on a scale from I to V, based on the number of required semi-squads (4 persons) and squads (6 persons) [11]. Therefore, in my view, it is a good indication of the seriousness of the event from a fire safety perspective. For most fires, a level I alert is sufficient. These are simpler incidents from a fire safety standpoint, and I have therefore excluded them from the analysis.

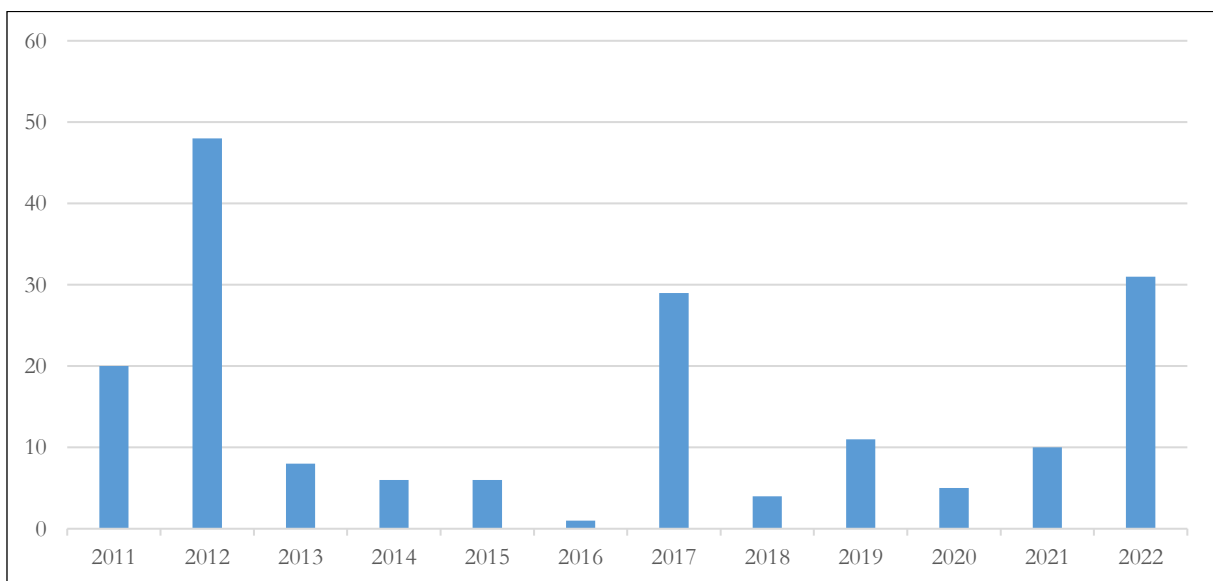


Figure 5.: Alert levels above I (made by the author)

The average is just under 15. Four years are above average: (1) 2012, (2) 2022, (3) 2017, and (4) 2011. There was only one such fire in 2016 (II). The highest level V was required in 5 years, 10 times in total.

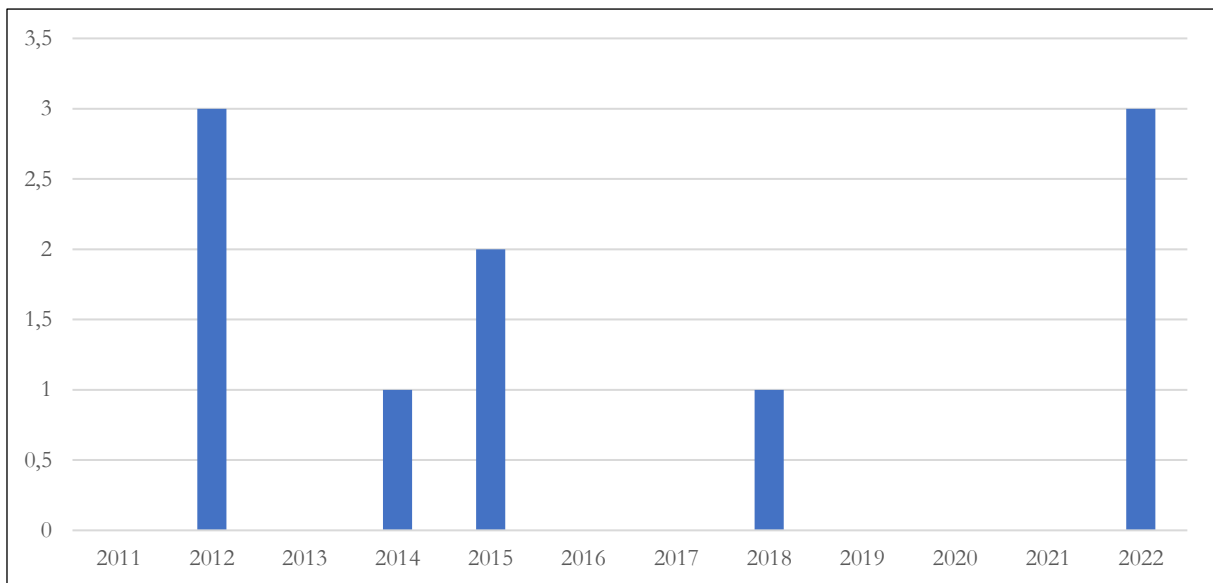


Figure 6.: Trend of alert V (made by the author)

2.3 The size of the burnt areas

Of the total area burnt in the period under study, 65% was less than 0.01 km², 34% between 0.01 and 0.3 km², 0.8% between 0.3 and 1 km², and 0.2% over 1.0 km². The first two categories have shown an increasing trend over the last few years.

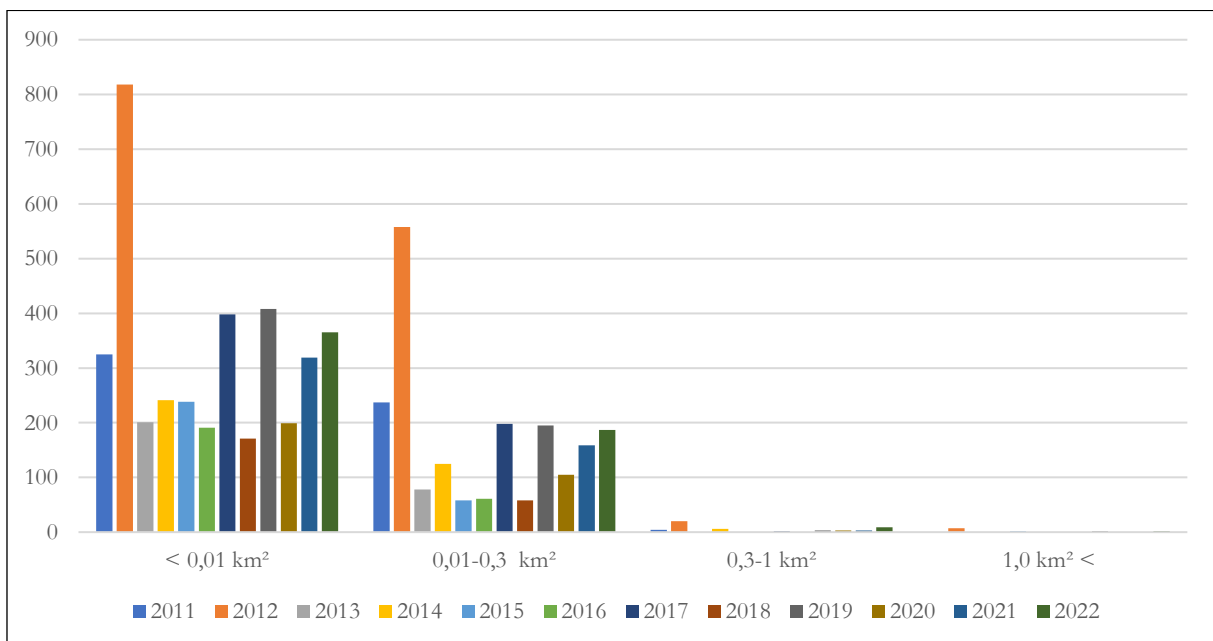


Figure 7.: Evolution of fire affected areas (made by the author)

Fires of the volume range of km² usually occur in drier years. Statistics show that the area of large, long-lasting fires in our county is decreasing.

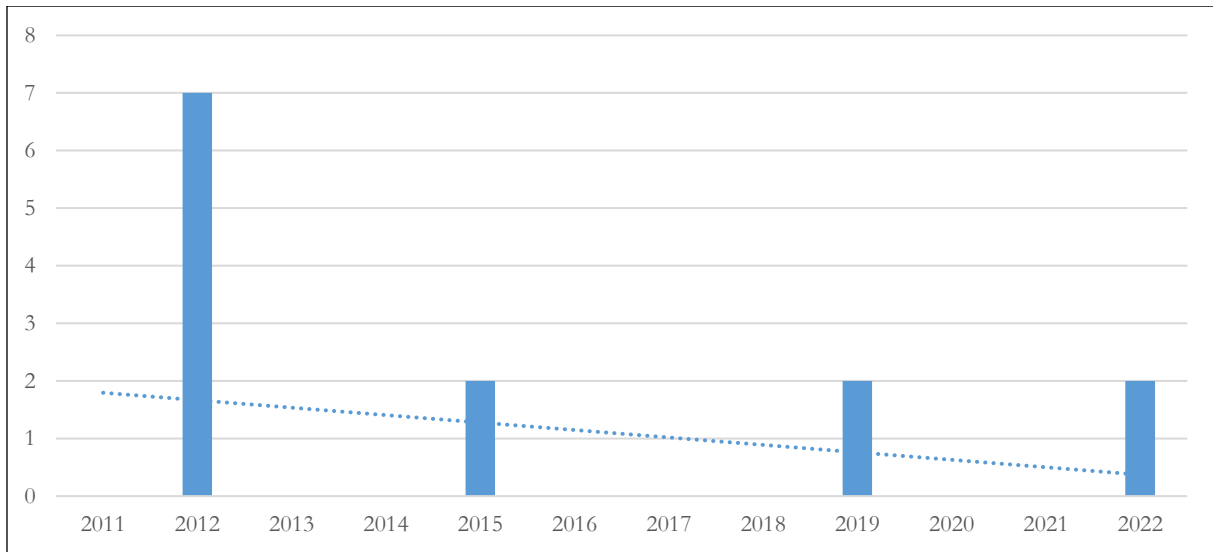


Figure 8.: Trend of fire areas (km²) (made by the author)

2.4 Fire fatalities

Most fire-triggered deaths occur indoors, in buildings. Unfortunately, they also happen in forest and vegetation fires.

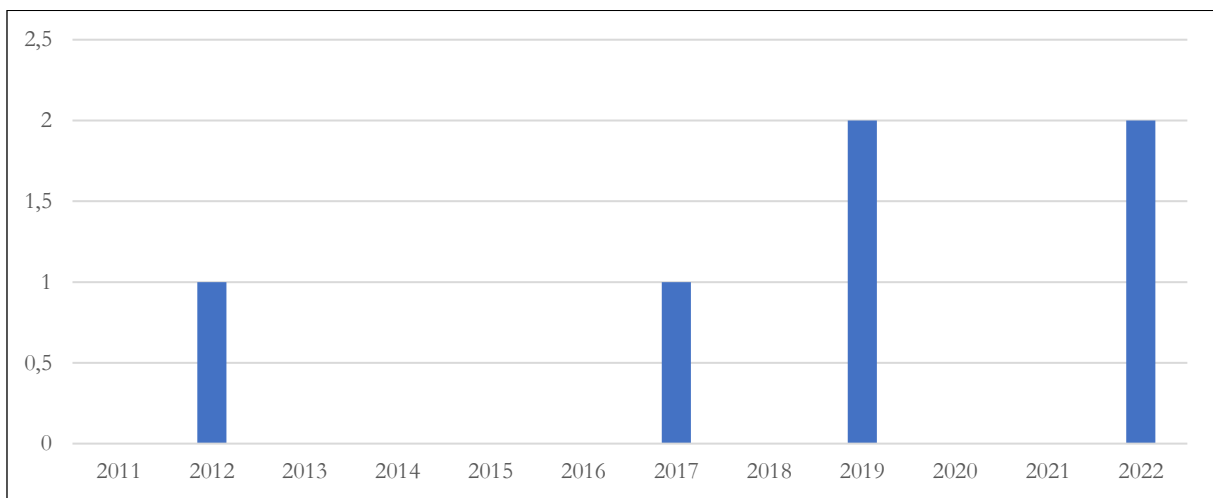


Figure 9.: Number of deceased citizens (made by the author)

The six death cases mentioned above are associated with six different incidents. Based on the results of fire investigations, they can be attributed to careless open-air burning, affecting predominantly elderly people. It is noteworthy that all these cases occurred in the eastern part of the county. Furthermore, Izsák was involved in both 2019 and 2022.

2.5 The risk level of forest areas

The classification of forests is crucial for assessing their vulnerability. Forest stands are categorized as high, medium, or low risk according to a set of criteria [1]. The area at risk is approximately 550 km², predominantly covered by pine and juniper forests [13, p. 12].

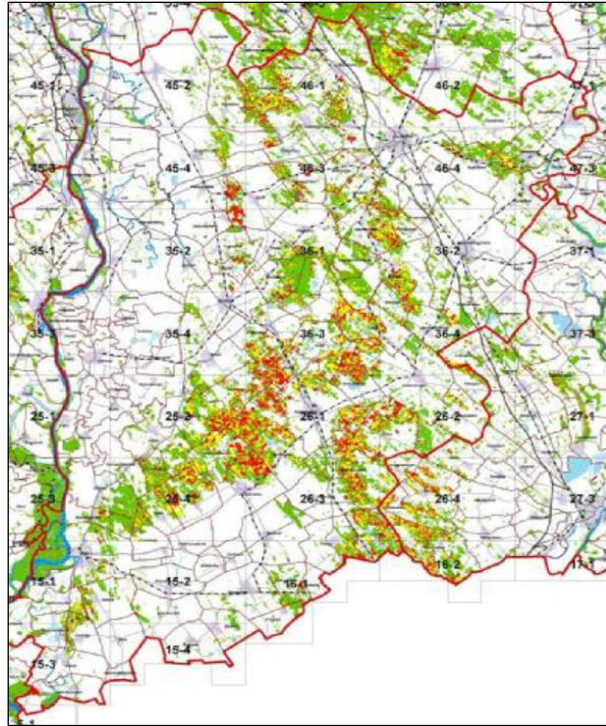


Figure 10.: Forest areas of fire risk in Bács-Kiskun county (Source: [13])

A third of the county's area is at high risk, identified by municipality using the County Forest Fire Protection Plan [13]. Of the 119 municipalities, 81 were affected. There are 40 settlements with a median area (about 3 km²) (see table), and 19 settlements have an area of more than 15 km² (highlighted in red). Kiskunhalas and its surroundings have high area coverage, and forest blocks of more than 10 km² are typical in this area [13, p. 13].

Ágasegyháza	Érsekhalma	Kecskemét	Nyárlőrinc
Baja	Hajós	Kelebia	Pirtó
Balotaszállás	Harkakötöny	Kéleshalom	Rém
Bócsa	Helvécia	Kerekegyháza	Soltvadkert
Borota	Imrehegy	Kiskunhalas	Szabadszállás
Bugac	Izsák	Kiskunmajsa	Szank
Bugacpusztaháza	Jakabszállás	Kisszállás	Tázlár
Császártöltés	Jánoshalma	Kunadacs	Tompa
Csátalja	Jászszentlászló	Kunbaracs	Vaskút
Csávoly	Kaskantyú	Kunfehértó	Zsana

Figure 11.: Settlements at risk (made by the author)

2.6 Weather impacts

I also considered it essential to check the weather conditions. For the given period, I collected data on the average mean temperature (°C), precipitation (mm), the number of days with precipitation, the number of hours of sunshine/global irradiance (MJ/m²b), the number of heatwave days, and the number of days with a heatwave per year [14]. The values refer to Hungary because I did not have such data for Bács-Kiskun county.

I assigned an annual value to each weather condition in order of magnitude, where a higher value always indicates conditions more favorable for vegetation fires.

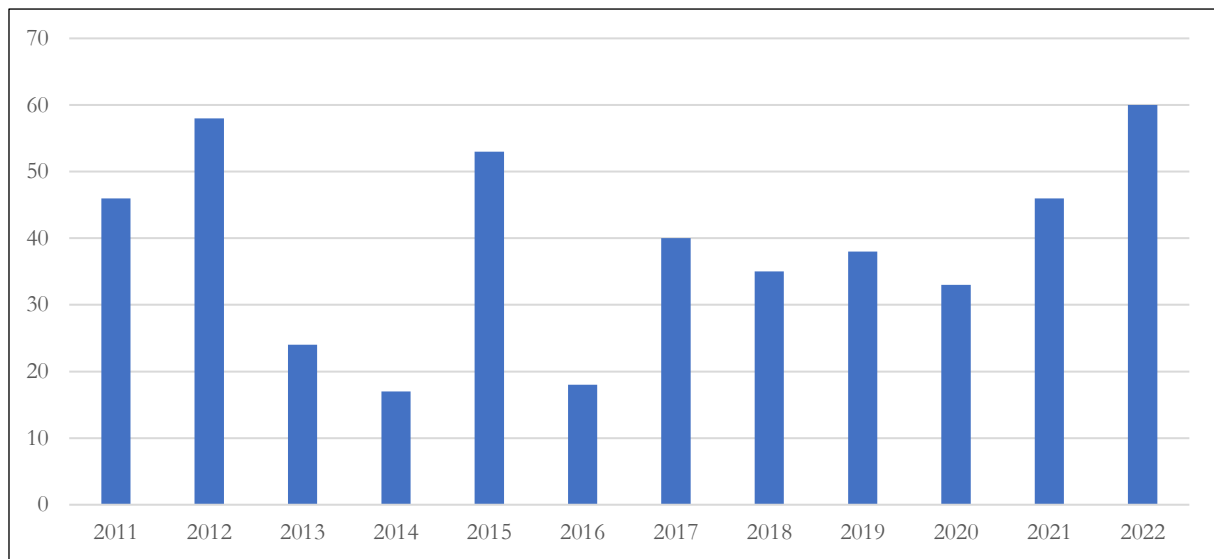


Figure 12.: Aggregated weather values (made by the author)

Half of the years are above average, and half are below average. The upward trends are seen in 2012 and 2022 (with similar magnitudes) and 2015. Three years are close to the minimum: 2013, 2014, and 2016.

3. LONG-LASTING, LARGE-SCALE FIRES

I distinguish between particularly large forest fires using the adjectives "long-lasting" or "large-scale." Their common characteristics are:

- They potentially threaten an area of at least 0.5-1 km²;
- Extinguishing them may take several day;
- They require the involvement of additional organizations and resources, in addition to the firefighting forces at alert level V/K;
- The management of firefighting is handled by a complex structure.

During my research work, I managed to collect and process studies and reports on forest fires in Bács-Kiskun county over the last 30 years.

The fire that occurred from 18 August to 30 August, 1993, covered an area of about 20 km² in the Bócs area of the Kiskunság National Park. There had been no significant rainfall since spring. The forest is dominated by black and Scots pine, poplar, acacia, and juniper. The surrounding area, approximately 100 km², is bordered by Orgovány, Kaskantyú, Páhi, Bócsa (these settlements were prepared for possible resettlement), and Bugacpusztaháza. Twenty-one farmhouses had been built in or near the forest. In addition to private property and national park areas, the Kiskunság Forestry and Timber Company (Kiskunsági Erdészeti és Faipari Zrt, KEFAG) was also affected. The area is a former non-exempted military firing range, characterized by very difficult terrain and a poor road network. Inaccurate and delayed fire warnings also hampered the start of the intervention. Several units could not be alerted because they were intervening in other incidents. The command mode was a management squad on 12-hour shifts, with the region's republican commissioner also setting up a crisis team. On-site news distribution was challenging due to a lack of coverage and radios. Airborne firefighting and helicopter aerial reconnaissance were employed, sometimes involving up to eight aircraft. Military units were eventually deployed to provide logistics.

Additionally, the army contributed equipment and personnel to extinguish the fire. Airborne firefighting brigades and fly ash brigades were also organized. A map of sufficient scale and accuracy was not available for a long time. The nearest water supply point was 6 km away. Burning back (up to two days later) was typical due to hidden glowing and smoldering parts. No smoke evacuator was available. On 26 August, rain finally occurred, and the area was handed over to the Kiskunság National Park for guarding [15].

The forest fire in the outskirts of Ágasegyháza lasted from 11 June to 20 June, 2000, covering an area of about 5 km². The site of the fire was a contiguous area of approximately 25 km², including forests, groves, and farmland bordered by Ágasegyháza, Izsák, and Orgovány.

The outskirts of the villages extend directly into the forested area. The soil is sandy, with few and challenging roads. The planted forests are typically black and Scots pine (around 80%) and juniper in the Kiskunság National Park area (10%). The fire alarm was triggered by careless firefighters cooking dinner outdoors in the farmyard. Due to increasing winds, they returned to the building and left the fire unattended. Hundreds of soldiers and 12 fire engines, among others, were involved in firefighting. At the peak, 365 people were working on the scene with 49 technical tools. Military helicopters (MI-8 / MI-17) and private aircraft (SMELÁK Z-137) were also engaged in firefighting.

The management squad operated on a 12-hour shift. Communication issues were encountered, for example, with aircraft. BÁCSVÍZ assisted in transporting firefighting water with tankers. Difficulties arose in "background" tasks, such as providing supplies on-site. The area was eventually handed over to the Kiskunság National Park after the firefighting was complete [16].



Figure 13.: The home-made cooking area in Ágasegyháza (Source: [16])

In July 2007, there were 12 V/K, 2 IV/K, 11 III/K, and 14 II/K forest and vegetation fires. Between Kunfehértó and Kéleshalom, there was a fire affecting about 10 km² (mostly pine forest) from 25 to 30 July 2007.

This incident was accompanied by a smaller forest fire nearby, in Imrehegy, but it required V/K forces. The fire, originating on the outskirts of Kéleshalom, spread rapidly, with strong winds causing hundreds of hectares to burn within a short time. An alert level exceeding V/K was necessary, involving a maximum of 25 vehicles, 4 helicopters, and 100 firefighters. A fire train provided extinguishing water at Kunfehértó station as a special tool. Difficult terrain, high temperatures, long-distance transport of extinguishing water, and limited radio communication were all complicating factors. Simultaneously, a fire of about 25 hectares threatening a poultry farm on the outskirts of Imrehegy was extinguished by 6 vehicles and 21 firefighters. In parallel, during the evening hours, about 30 hectares of mixed pine forest burned on the outskirts of Pirtio. Under the leadership of the mayor, 40 local residents assisted with 4 fire engines, and the municipality took care of guarding the area. One private helicopter, the MI-2 helicopters of Forgószárny Kft. Forwarding Company, two MI-8 helicopters of the Hungarian Defence Forces, experts from the Kiskunság National Park, and experts and forestry machines of KEFAG Zrt. were involved. On the first day, about 230 civilian volunteers helped with hand tools to extinguish the fire. The complex intervention was carried out by a management team [17].

A forest fire occurred in the Bugaci Primeval Forest from 29 April to 4 May, 2012, damaging an area of about 9 km². The Bócsa-Bugac core area is about 22 km². A fire protection network wasn't established. The fire spread very rapidly due to strong winds. The area is highly fragmented, sandy, with forest areas that are difficult to access. An 80 m² research building and a lookout tower were burnt. In addition to the adjacent contiguous forest, the fire also threatened farms and livestock buildings. Firefighters had to be called to the scene because of the non-exempted former military firing range taking up a part of the area. To extinguish the fire, the fire chief also ordered aerial extinguishing.

The aerial reconnaissance was carried out by a small fixed-wing aircraft donated by a private person, and aerial firefighting was realized by the MI-8 "Bambi Bucket" of the Hungarian Defence Forces and the firefighting by the Rotary Wing Ltd. MI-2 internal tank helicopter of the type "Bambi Bucket" [18].



Figure 14.: Air reconnaissance in Bugac (Source: [18])

Due to the size and duration of the incident, the changeover had to happen at the scene of the damage. It was also necessary to ensure the supply of intervention teams, replenish vehicles with water and fuel, and maintain the continuous operation of the command post. Extinguishing water was delivered from distances of 4.5 and 9.5 km, with the assistance of a milk truck. The successful intervention required the coordinated work of several organizations, with a crucial role played by the Kiskunság National Park and KEFAG Zrt. The latter's heavy forestry machinery, along with the Aquarius (a 500-litre tank sprayer with an explosive pump capable of producing 6-8 bars), proved useful. Several voluntary firefighting associations and civilians also contributed to firefighting efforts. To manage the many curious onlookers, the police assisted in cordoning off the area. At the peak, 139 people were working on the scene with 37 modes of technical equipment. The complex intervention was assisted by a management team working in 24-hour shifts. Communication was hampered by poor coverage. While the fire investigation could not conclusively determine the cause of the fire, the exact location of its origin could be determined. Presumably, due to careless open flame activity, the poplar fir and then a juniper bush caught fire. Based on previous experience, the positive impact of navigation field guidance exercises, organizational and logistical measures, and internal training was noticeable compared to the 2007 forest fires. A complex case study, based on the lessons learned from the fire, resulted in several recommendations for improvements at county level and in legislation. The Bács-Kiskun County Disaster Management Directorate also organized a national conference on this in March 2013 [19].



Figure 15.: Destroyed observation tower, burnt firefighting equipment in Bugac (Source: [18])

From 24 July to 28 July, 2015, there were alert V/K forest fires in the national park area, mostly located outside Kaskantyú. Additionally, from 26 July to 28 July, 2015, there were fires in the area of 2.5 km² and 4 km², respectively, outside Kiskunhalas. The incident in Kaskantyú was detected by a police helicopter. The contiguous site, covering about 50 km², is part of the Kiskunság National Park (which provided great assistance throughout the firefighting). It consists of a pine forest with pine trees and partly includes a former non-exempted military firing range, resembling the site of the fire in Bócsa in 1993. The first fire brigade took hours to reach the site due to the difficult terrain, with assistance from the conservation officer. A police helicopter aided in aerial reconnaissance, and later, the Forgószárny Kft. MI-2 helicopter of the Forwarding Force arrived on the scene for aerial firefighting. Water supply was provided by the fire hydrant network of the municipality of Páhi from a distance of 6 km. The fire was caused by lightning [20].



Figure 16.: Airfield in Kaskantyú (Source:[20])



Figure 17.: Decision support system interface (made by the author)

In the Rekettyepuszta suburb of Kiskunhalas, the fire directly threatened five farm properties and a MOL oil production and collection facility. There was intense foliage, and the fire spread rapidly. Although privately-owned black pine stands burned, KEFAG Zrt. also assisted at the scene. Water was provided through long-distance water delivery, but the 60 m³ water tank in the oil well area was filled by three MOL trucks to ensure a continuous water supply. The forest area saved exceeded 2300 hectares.

The Eurocopter MD 500 helicopter of the Hungarian Police and the two MI-8 helicopters of the Hungarian Defence Forces assisted in aerial reconnaissance and aerial firefighting. The cause of the fire is unknown, but presumably it was due to human activity [20].



Figure 18.: Difficult terrain dosed gaps from 2015 (Source: [20])

A total of five volunteer firefighting associations assisted in the firefighting, and the district Fire Kunok Rescue Team also intervened in Kiskunhalas. During the parallel period, the management team's operation was continuous at both sites, and the logistical support (management points, supplies, etc.) successfully managed both incidents. The Bács-Kiskun County Disaster Management Directorate's proprietary geo-information-based forest fire decision support system was also utilized [20].



Figure 19.: Kiskunhalas MOL plant in the forest, an MI-8 helicopter in the sky in the background during aerial firefighting (Source: [20])

In July 2022, the international and national press were full of news about forest fires. Three alert V/K fires occurred in Bács-Kiskun county. The events were very well predicted by the European Forest Fire Information System, which we used for our preparations.



Figure 20.: EFFIS Current Situation on 13 July 2022 (made by the author)

Between 13 July and 16 July, 2022, 0.05 km² of an old black pine forest of about 3.3 km² between Izsák and Soltszentimre was partially crowned by fire. A serious complication was that two III/K fires were ongoing in the county simultaneously, and three other county fire engines scheduled to assist were also on damage. The very rapid fire spread directly threatened the intact portions of the horse ranch, 5 occupied farmsteads, and 12 km² of dry reeds on Kolon Lake [21].



Figure 21.: Burning in a crown in Izsák (made by the author)

The rapid identification of the farmhouses is thanks to the aerial reconnaissance by a police helicopter. The difficulty in obtaining fire water was due to the fact that the drinking water network in Soltszentimre was almost empty, and water could only be obtained from Fülöpháza, the closest source. Two S10 water trucks and 12 mobile extinguishing water basins were used to create a 30 m³ reserve. During firefighting, one main casualty was found in a burnt building. The fire investigation concluded that the fire was caused by negligence. The individual was cooking outside the house on an open flame, which he had left unattended. The incident is eerily reminiscent of the 2000s in Ágasegyháza [21].



Figure 22.: Two S10 water conveyors and mobile extinguishing water basins (made by the author)

Between 14 July and 16 July, 2023, 0.7 km² of a 5 km² forest block burned in Matkópustá, Kecskemét. Part of the forces had to be redeployed from the Izsáki fire, which was 50 km away. The proximity of the residential area, rapid fire spread, and problems caused by smoldering stumps were greatly assisted by some 30 shovelers and heavy forestry equipment from KEFAG, as well as drone reconnaissance used from the start. The outcome of the fire investigation remains unknown, but human negligence is presumed [21].

From 21 July to 26 July, 2022, about 1 km² of pine and mixed forest burned in a large forest block outside Kiskunhalas. Farms and animal shelters were threatened but successfully saved. It caught fire again 10 days after it was extinguished, but the area was monitored by the forest manager [21].

The management teams, intervention staff, and technology worked effectively even in the case of parallel fires. The assistance of municipal fire brigades and volunteer fire brigades was also a great help in the fires, particularly in the "protection of the cities." The logistical support was adequate throughout; they were able to set up and operate two command points simultaneously and then provide supplies to both alert V/K fire forces. The drones provided by the volunteer fire brigades and the BM OKF were used effectively in all three fires in 2022 [21].



Figure 23.: Drone reconnaissance in Matkópuszta (made by the author)

4. SUMMARY

Forest and vegetation fire trends, especially in recent years, show an upward tendency. In terms of districts, most fires occurred in the districts of Kiskőrös, Kalocsa, and Kecskemét. Looking at the number of cases per population, 12 of the top 15 are in Kalocsai and Kiskőrösi districts, with Drágszél and Öregcsertő standing out.

The vast majority of burnt areas were below 0.3 km². The size of the burnt areas seems to be slightly decreasing. This is particularly striking for the three large, long-lasting forest fires of 2022, which did not exceed 1 km². This indicates an increase in firefighting efficiency, especially when compared to 2007 and 2012.

The number of fire fatalities is also high, with six in 12 years, unfortunately in similar circumstances. Fire deaths tended to occur in the northern part of the county, as opposed to the central part of the county, which had a higher number of incidents.

Forest areas with a high fire risk affect most of the municipalities in the county. The area of Kiskunhalas and its surroundings is highly affected, but the size of the highly endangered forest areas exceeds 3 km² in 40 settlements and 15 km² in 19 settlements.

Examination of meteorological data confirms that the evolution of fires depends on the weather. However, comparing 2012 and 2022 in similar circumstances, we see that the number of fires in the latter is less than half of the former. This was certainly influenced by ten years of intensive fire prevention activities. The high value of 2015 asks for attention. The total number of incidents is

well below average, but there were two large alert V/K fires in July. The extreme weather effects were probably over a shorter period but very intense.

The alert levels highlight three years (2012, 2017, 2022). Both 2012 and 2022 are priority years for practically all aspects studied, while 2017 is a priority year for several reasons. However, in 2017, no long-lasting, large-scale wildfires occurred, unlike 2015, as discussed above.

The probability of long-lasting, large-scale wildfires in our county remains at 5-7 years. The question is not if such a fire will occur but when. Climate change will likely increase their intensity, posing a potential threat to infrastructure, buildings, and people in their vicinity. In Hungary, there is still no regulation on the relationship between different tree species and buildings. Large fires do not occur only in the usual places (Kiskunhalas and the Bugac-Bócsa area) and periods (July). For example, the fire in Bugac in 2012 occurred in April, and in 2022, there were alert V/K forest fires in the outskirts of Izsák and Kecskemét. The forest fires of 2007 triggered common reflection, and the 2012 Bugac fires accelerated progress. We routinely incorporate the lessons learned into our internal training, and annual logistics, navigation, and field management exercises have become a tradition. We have developed a geographic information-based decision support system, which we have been using for almost ten years. With the new 10 m³ S10 water trucks, the heavy category S3 vehicle, the AMAROK light forest fire trucks, a command post container (with tools and light field protective clothing), the quads, and the existing UNIMOG forest equipment, we have obtained tools from various KEHOP projects that make our interventions even more efficient. For larger fires, we have learned to use drone reconnaissance. The involvement of volunteers is a great help for large, protracted fires. Cooperation with the Kiskunság National Park and KEFAG Zrt. has also become almost routine.

We can say that in the last 30 years, but especially in the last ten years, the fire protection of forests in Bács-Kiskun County has improved significantly. The conscious and planned collection and processing of firefighting experience and local specificities make interventions more effective. However, as one of the last elements of fire protection, a comprehensive evaluation and optimization of the relevant legislation and internal regulations has not yet been carried out. Furthermore, due to the increasing forest fire risk, we need to explore areas where we can optimize and improve. Therefore, based on my current research, I make the following recommendations:

- Developing the concept of fire protection of forests.
- Starting a more detailed analysis of statistical and meteorological data at the municipal level.
- Exploring possibilities for developing a geo-spatial decision support system (e.g. accessibility on mobile devices, updating and expanding the database).
- Expanding the scope of known vulnerable infrastructure and facilities in the vicinity of high-risk forest areas, developing specific recommendations for prevention (e.g. survey of inhabited farms and development of recommendations for forest-building linkages).
- Developing area-specific public information methods and materials.
- Initiating the adaptation of forest fire warning and detection capabilities at county level and develop specific recommendations for public behaviour, with particular attention to remote sensing.
- Assessing and processing personal experiences of managers and intervention staff in order to further develop internal training and methodologies (in particular firefighting tactics).
- Organising new workshops and conferences, building on the tradition of previous forest fire conferences.
- Seeking opportunities for cooperation with other institutions and researchers.
- Initiating a comprehensive, experience-based study of the legislation and internal regulations on forest fire protection and preparing proposals for optimisation based on the results.

5. REFERENCES

- [1] “4/2008. (VIII. 1.) ÖM rendelet az erdők tűz elleni védelméről,” Nemzeti Jogszabálytár, 2023. [Online]. Download: <https://net.jogtar.hu/jogszabaly?docid=a0800004.onm> (30.07.2023)
- [2] NASA, *Aqua/MODIS satellite image Bugac*, 29.04.2012.
- [3] Gróbné Szenyán I. Országos Meteorológiai Szolgálat, 2012. [Online]. Download: https://www.met.hu/ismeret-tar/erdekesssegek_tanulmanyok/index.php?id=194 (30.07.2023)
- [4] Gyapjas J., „Térinformatikai döntéstámogatás erdőtüzeknél – megelőzési tapasztalatok, fejlesztési javaslatok,” Védelem Online, 2020.
- [5] „Nagy tűz pusztított Bács-Kiskun megyében, halott is van,” INFOSTART / MTI, 2022. [Online]. Download: <https://infostart.hu/belfold/2022/07/14/nagy-tuz-pusztitott-bacs-kiskun-megyeben> (30.07.2023)
- [6] „Újabb erdő ég Magyarországon,” index.hu, 2022. [Online]. Download: <https://index.hu/belfold/2022/07/14/erdotuz-kecskem-et-tuzoltok-szarazsag/> (30.07.2023)
- [7] L. Bodnár és P. Debreceni, „Implementation of Wildfire Risk Evaluation Elements into the Hungarian Forest Fire Prevention System,” *Hadmérnök*, , pp. 75-99, 2022.
- [8] United Nations Environment Programme, „Spreading like Wildfire – The Rising Threat of,” UNEP Rapid Response Assessment, Nairobi, 2022.
- [9] „European Forest Fire Information System,” EU Joint Research Centre, 2023. [Online]. Download: <https://effis.jrc.ec.europa.eu/> (30.06.2023)
- [10] Copernicus Atmosphere Monitoring Service. „Europe’s summer wildfire emissions highest in 15 years,” European Commission, 2023. [Online]. Download: <https://atmosphere.copernicus.eu/europes-summer-wildfire-emissions-highest-15-years> (30.07.2023)
- [11] „39/2011. (XI. 15.) BM rendelet,” Nemzeti Jogszabálytár a tűzoltóság tűzoltási és műszaki mentési tevékenységének általános szabályairól [Online]. Download: <https://njt.hu/jogszabaly/2011-39-20-0A> (30.07.2023)
- [12] BM OKF, *KAP-Online adatbázis*. 6/2014. (III. 7.) BM OKF utasítás Download: BM OKF Intranet Normatár
- [13] MgSzH Központ Erdészeti Igazgatóság, Bács-Kiskun Megyei MgSzH Erdészeti Igazgatóság, BM OKF, Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *Bács-Kiskun Megye Erdőtűzvédelmi Terve*, Budapest, 2009.
- [14] Központi Statisztikai Hivatal, „Magyarország időjárásának adatai,” [Online]. Download: https://www.ksh.hu/stadat_files/kor/hu/kor0037.html (30.07.2023)
- [15] Bács-Kiskun Megyei Tűzoltó Parancsnokság, *TANULMÁNY az 1993. augusztus 18-tól augusztus 30-ig tartó KISKUNSAGI NEMZETI PARK BÓCSAI TERÜLETÉN TÖRTÉNT ŐSBORÓKÁS TŰZESETRŐL*, Kecskemét, 1993.
- [16] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *TANULMÁNY a 2000. június 11-től június 20-ig tartó Ágasegyháza külterületén történt erdőtűzről*, Kecskemét, 2000.
- [17] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *Tanulmány a Bács-Kiskun megyében 2007. július hónapban bekövetkezett erdőtüzekről*, Kecskemét, 2007.
- [18] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *Komplex esettanulmány a 2012. április 29-én Bugacon*, Kecskemét, 2012.
- [19] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, „Erdőtűzvédelmi kiállítás” Védelem Online, 2013. [Online]. Download: <https://www.vedelem.hu/hirek/1881-nyolcszorosan-tulbiztosit-az-uj->

[rosenbauer-vedoruha/1459-erdotuzvedelmi-konferencia-kiallitas-es-teruletbejaras-kecskemeten.](#)
(30.07. 2023.)

- [20] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *Eseti művelet-elemzés a 2015. július 24-28. közötti nagy kiterjedésű, hosszán tartó erdőtüzekről Kaskantyú és Kiskunhalas térségében*, Kecskemét, 2015.
- [21] Bács-Kiskun Megyei Katasztrófavédelmi Igazgatóság, *Összefoglaló jelentés*, Kecskemét, 2022.
- [22] BM OKF, „BM OKF adatbázisok,” [Online]. Download:
<https://www.katasztrofavedelem.hu/application/uploads/common/26/16/7854/1579698789.xls>
(30.07.2023)