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Disaster Protection Analysis of the Storm Occurring on July 10, 2017 in Siófok

A 2017. július 10-én Siófokon bekövetkezett vihar katasztrófavédelmi szempontú elemzése

One of the main consequences of climate change is extreme weather conditions that cause droughts, aridity, torrential rains, cyclones, and storms. The author's twenty-year experience as a professional firefighter also supports that the number of interventions increased due to extreme weather conditions. The number of fires decreased; however, technical rescues (damages caused mainly by storms and water) show an increasing trend in Hungary. The author argues that to perform effective interventions in the future, it is necessary to analyse and examine the methodology of the interventions.

Keywords: *climate change, extreme weather, disaster management*

Az éghajlatváltozás egyik fő következménye a szélsőséges időjárás, amely magával hozza a szárazságot, aszályt, özönvízszerű esőzéseket és a ciklonok, viharok kialakulását. A szerző hivatásos tűzoltóként eltöltött húsz évének tapasztalatai is azok, hogy a szélsőséges időjárás miatt a beavatkozások száma megnövekedett. A tűzesetek száma csökkent, de a műszaki mentések (főként a viharkárok, víz által okozott károk) növekvő tendenciát mutatnak Magyarországon. A szerző véleménye, hogy a jövőbeni hatékony beavatkozás érdekében elemezni, vizsgálni szükséges a beavatkozások metodikáját.

Kulcsszavak: *éghajlatváltozás, szélsőséges időjárás, katasztrófavédelem*

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1. Introduction

The twentieth century is also known as the century of disasters. In the twenty-first century, it is apparent that disasters have increasingly intense and extensive impacts, requiring greater complexity of interventions.[2] Having been created from firefighters and civil protection predecessors, the Disaster Management Organisation had to face challenges, dangers to civilisation, natural disasters, human and ecological threats. Threats of natural disasters were predicted to be of hydrological, geological, and meteorological origin.[3] By their nature, extraordinary weather events fall into the category of natural disasters, in addition to geological, hydrological, and biological disasters, which may occur in close interaction with each other or on their own.[4] High-ranking and professional leaders and educators of disaster management also identify extreme, extraordinary weather events as potential sources of danger. Those events pose a cumulative threat to human life and material goods, and their elimination requires increased attention and professional competence.

Extreme weather conditions and their consequences can affect the manufacturing process, storage, or transportation of hazardous materials. According to a research made by the European Commission's Joint Research Center on technological – so-called NaTech (Natural hazard-triggered technological) – accidents caused by natural disasters, at least five percent of serious accidents or breakdowns involving dangerous substances can be attributed to natural hazards. An unexpected event involving the release of hazardous substances into the environment, thereby endangering human life, health and the natural environment, due to the occurrence of natural hazards (such as earthquake, floods, extreme weather events, lightning activity) can be considered a NaTech event.[5]

2. The purpose of the research

This paper aims at presenting the increased firefighting interventions due to extreme weather conditions through a specific mass damage event to facilitate development opportunities for the elimination of future damage events.

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[2] Árpád Muhoray and László Teknős, 'A HUNOR hivatásos nehéz kutató-mentő mentőszervezet alkalmazásának logisztikai feladatai [Logistical tasks of the application of the HUNOR professional heavy search and rescue organization], *Hadtudomány: A Magyar Hadtudományi Társaság Folyóirata* 25, no E (2015), 14–23.

[3] Árpád Muhoray, 'A katasztrófavédelem aktuális feladatai [Current tasks of disaster management], *Hadtudomány: A Magyar Hadtudományi Társaság Folyóirata* 22, no 3–4 (2012), 1–16.

[4] Árpád Muhoray, 'A katasztrófavédelem területi irányítási modelljének vizsgálata' [Examination of the territorial management model of disaster management], PhD dissertation, Zrínyi Miklós Nemzetvédelmi Egyetem, 2002, 132.

[5] Serkan Girgin, 'The natech events during the 17 August 1999 Kocaeli earthquake: aftermath and lessons learned', *Natural Hazards and Earth System Sciences* 11, no 4 (2011), 1129-1140.

3. Methodology

The data used for the present analysis and evaluation were provided by the database of the on-line Disaster Management Data Provider Program (hereinafter: on-line CAP). A segment of the CAP is the Firefighting and Technical Rescue Report (hereinafter: TMMJ), the electronic recording of the data sheets of substance, fire investigation, and forest and vegetation. The on-line CAP supports the acquisition of specific data for statistical use by setting different filters.

On the given days, the author also used his personal experience and took part in the remediation as a squadron leader. He also conducted interviews with experts in the respective fields.

The research (TMMJ) was started on May 14 on the internal network of the Disaster Management Directorate of Somogy County, Disaster Management Office of Siófok, and Professional Fire Brigade in Siófok.

4. An international outlook on extreme weather events

Extreme weather events have non-negligible effects that can take human toll, and have economic consequences in addition to the partially insured damages.

The Munich RE NatCatSERVICE is one of the world's most comprehensive databases for analysing and assessing losses caused by natural disasters. For this service, Munich RE has been systematically and in detail recording all relevant information on events resulting in losses worldwide for decades. Data that have been collected by the insurance industry since 1980 provide information on the evolution of extreme events. While these are not direct indicators of extreme weather events, and previous records may not include all devastating events, they do show that the number of weather-related disasters recorded around the world is on an increasing trend.

Overall, natural disasters caused by extreme weather events have taken nearly one million lives since 1980, and caused losses of about $ 4.2 trillion. It can be stated that extreme weather events pose a great risk and challenge to humanity in terms of both human life and material damage.

Restricting the scope of examination to the territory of the European Union, it can be stated that extreme weather events are the main factors among the risks identified in the countries participating in the Civil Protection Mechanism. A total of 34 countries are participating and 11 risk factors have been identified. In a landmark article, László Teknős specified the main risks identified in the countries participating in the EU Civil Protection Mechanism; the 34 countries concerned are most at risk of flooding (identified in a total of 30 countries). Extreme weather events are considered a major threat (identified in a total of 26 countries).[6]

6 László Teknős, 'A klímaváltozás, mint új kihívás megjelenése az Európai Unió Polgári Védelmi Mechanizmus feladatrendszerében' [Emergence of climate change as a new challenge in the European Union's Civil Protection Mechanism], *Hadtudomány: A Magyar Hadtudományi Társaság Folyóirata* 28, no E (2018), 188–210.

5. Meteorological background of the storm of 10 July 2017

The processing of this chapter, the presentation of the subject, was prepared based on a case study of the Hungarian Meteorological Service (OMSZ) related to the storm. A wild thunderstorm hit the eastern part of Lake Balaton in the evening hours of the said day. According to the measuring devices deployed by the Hungarian Meteorological Service at Balatonaliga, the speed of the hurricane-like wind reached 157 km/h. In the Lake Balaton area such a high wind strength has not yet been measured with an authentic instrument. The storm left behind an unprecedented spectacle at Lake Balaton that could have fit into disaster films.

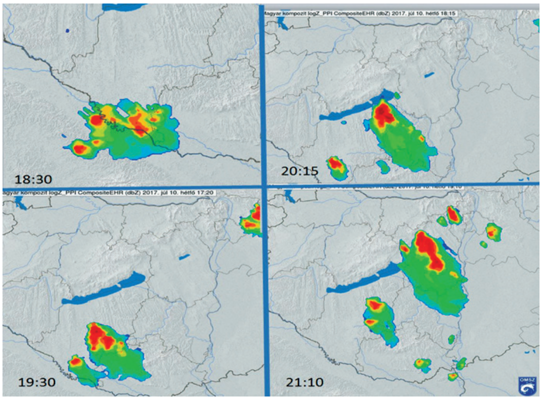

Figure 1. The migration of thunderstorm cells over Southern Transdanubia according to the measurements of the OMSZ's radar network. In the figure, times are understood in local time.
Source: Ákos Horváth and Kálmán Csirmaz, 'Heves zivatarok, légzuhatagok a Balatonnál' [Fierce thunderstorms, airstrikes at Lake Balaton].

Crossing the Croatian–Hungarian border and the line of the River Drava, the first significant thunderstorm cells appearing on July 10 at about 6 p.m. moved north-east. Moving towards Lake Balaton, they became stronger and stronger as it was fed by the warm air near the ground and the humidity from the higher layers.

In addition to the thermal energy, the wind increased with the altitude also contributed to the fact that the cells began to rotate and thus reached the settlement of Karád in Somogy County in a supercell state as a swirling thunderstorm cloud. According to eyewitnesses, the wind, which blew the clouds and in some places changed into a whirlwind, twisted trees and damaged roofs, and was responsible for much damage. The presence of the whirlwind assumes that the inflow and outflow areas of the supercell could not be at great distances from each other.

The 'spinning effect' of the atmosphere was already observed in the Balaton area an hour before the storm, in the form of small cumulus clouds. The storm cell approaching Lake Balaton from the southwest was visibly a very developed and powerful formation, with a wide anvil and a rim cloud indicating the downdraft. As the cell reached Lake Balaton after 8 p.m., the violent, concentrated downdraft was visible, causing a stormy wind to hit the ground in a small area. Such concentrated downdraft is called a downburst and is a feature of particularly severe thunderstorms.

The phenomenon is just the opposite of a tornado: while in a tornado, the air flows inwards into the cloud in a narrow channel (sometimes only a few times ten meters in diameter), in a relatively limited area (sometimes only 1-2 km in diameter) it flows out of the cloud in a concentrated manner. The downdraft is often accompanied by rain and ice. If wind speed is above 100 km/h and accompanied by cherry-sized or larger ice grains, it may have a devastating effect, comparable to a shower of bullets. In addition to crops, it can severely damage the roofs of residential houses, windows, shutters, or even the plaster of buildings. The instrument of the Hungarian Meteorological Service in Balatonaliga registered a speed of 157 km/h in the wake of the passing supercell. The hurricane-force picked up water from the surface of Lake Balaton to such an extent that the vision reduced to 1-2 meters, the boats stored on the shore overturned, and the wind turned healthy trees uprooted. Similarly, there were plenty of tree fallouts in the eastern and southern areas of Siófok, along with frequent ice damage, accurately outlining the route of the supercell.[7]

6. Disaster protection analysis of situation in damaged areas in Siófok

The first step is to examine the history, to investigate the factors that led to the occurrence of mass damage events. The meteorological history was discussed in the previous main chapter, so it will not be presented again.

By comparing and analysing the obtained results, the evolution of similar situations in the future or the extent of their development can be influenced. First, the built and natural environment existing on a given section of the shore of Lake Balaton will be presented.

The storm caused the most havoc in Baross Gábor street in Siófok. This street is located between the southern shore of Lake Balaton and the railway lines, with a length of 5.5 kilometers. The plots belonging to the street are large, and in some places, the percentage of built area is also very high. Most of the properties in the area are only used during the summer, so the vast majority are not permanently inhabited. The big problem is that most of the buildings had been built next to the trees, which outgrew them by 10–15 meters.

As for vegetation, a large percentage of the southern coast is covered with black pine. The Latin name of black pine is *Pinus nigra*, a tree that is native to southern Europe. It tolerates drought, light, sandy and chalk soils very well. It covers around 4 percent of the Hungarian forests, and it can be found as plantations on the sandy soils of the Hungarian Great Plain. The characteristics of a black pine are similar to those of a pine, however, due to its strongly nodular and coarse structure, its strength lags behind that of a pine.[8]

7 Horváth and Csirmaz, 'Heves zivatarok

8 'A feketefenyő' [the Black pine]. Sulinet.hu.

Black pine is much less suitable for sawmill processing than pine. Black pine is a low-density softwood. Regarding its mechanical properties, its hardness exceeds that of fir. Its roots are strongly branched, it hardly develops top roots.[9]

Figure 2. Black pine trees uprooted by the storm on July 11, 2017

Source: made by the author

Due to the shallowness of Lake Balaton and the relatively low viscosity of the warm summer water, waves form quickly on it in case of wind. The prevailing wind direction is northwest at right angles to the southwest-northeast location of Lake Balaton. The valleys and mountains of the Balaton Uplands cause a pulsation in the wind, which results in sudden waves and wave-free periods intermittently on the lake.[10]

On the southern shore of Lake Balaton (especially in the Siófok area), the regulation of the shoreline began in the late 1800s, at the time of the construction of the southern railway line.

Figure 3. Protective embankment on the shore of the Lake Balaton

Source: made by the author

[9] Ferenc Szilágyi, *Fák és cserjék* [Trees and shrubs]. Székelyudvarhely [Odorheiu Secuiesc], 1997–2001.

[10] 'A Balaton' [The Balaton]. Balatonivitorlázás.com.

A lake shore can be considered natural as long as human intervention does not play a significant role in the development of the lake bed. In the case of Lake Balaton, the first significant intervention started in 1960. With the development of tourism, a 70-kilometer-long shoreline was built until 1970, 28 kilometers between 1970 and 1980, 8 kilometers between 1980 and 1990, and 0.25 kilometers until 1995. Today, the length of the entire shoreline of Lake Balaton is 235 kilometers, of which 107.5 kilometers have built protective embankment, as shown in Figure 3.[11]

The section where the storm was 'raging' is also provided with coastal protection. The built and natural environment is almost intertwined, inseparable, as it is an aggradation area that nature has not taken possession of. The causes of mass damage should not be limited to weather conditions. It was greatly influenced and amplified by the built environment.

7. Presentation of disaster protection operations and firefighter interventions

To explain and understand the chapter more fully, a few concepts shall be defined here. Disaster response operation is an activity performed by the staff of the disaster protection organisation at the scene of the accident, with its regular means, equipment, and standby vehicles.[12] According to this, disaster management operations aim to prevent and reduce the loss of population and material assets endangered by disasters and other hazards and to quickly eliminate the consequences. To narrow the notion further: the site of damage is the area (with its population, livestock, buildings, facilities, and so on) that has been directly or indirectly affected by the disaster, and where interventions or restrictive measures to reduce the adverse effects (for example land closures, evictions, and so on) are necessary.[13]

Due to the nature and impact of the disaster, a meteorological damage site can form, and, in case of partial or joint occurrence, the staff is facing a combined damaged site situation. Depending on their size and dimension, damage sites can be divided into work areas separated by operational zone boundaries, to make better use of the possibilities of disaster management organisations and equipment and to organise operations more tightly. Depending on the intervention, there may be a technical rescue: during a natural disaster, an accident, damage, and abnormal technological process, a technical failure, the release of a hazardous substance, or any other emergency, one has to protect human life, physical integrity and property, carried out by primary intervention means.

The storm had not yet passed on July 10, 2017, at around 08:00, but the Somogy County Activity Control Center had already received mass calls for help. In Hungary, emergency calls (112, 104, 105, 107) run into call centers (HIK), of which one is located in Miskolc and the other in Szombathely. At the county level, the county or capital activity management centers

11 'Balaton partvonal szabályozási terv' [Balaton shoreline regulation plan].

12 41/2018. számú BM OKF Főigazgatói Intézkedés [BM OKF Director General Measure No. 41/2018].

13 118/2011. számú BM OKF Főigazgatói Intézkedés 1. számú melléklete [Measure No. 118/2011 of BM OKF General Director, Annex 1].

receive the data sheets arriving from the HIKs. In Siófok and Balatonvilágos, the storm uprooted trees onto the houses and the roads. The torn, fallen trees smashed cars and caravans beyond identification. A total of about eleven thousand consumers in 39 settlements fell out of the electricity supply.

There was no electricity in Baross street in Siófok either, which was blocked from traffic by the fallen trees. There was also a call for help from a nearby campsite where trees leaned on campers in the yard, causing several injuries. Saving lives was arduous because of the fallen trees on the street; it was only possible to reach the injured on foot.[14]

An operational staff was set up in Siófok. They consulted with the electricity supplier, whose staff worked continuously with the firefighters, disconnected the affected areas for the duration of the interventions, and then turned the power back on after the work was completed.

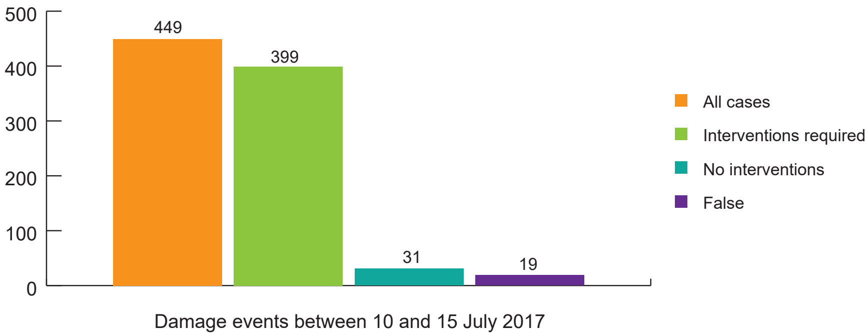

Figure 4. Damage events between July 10 and 15, 2017, according to the mode of interventions
Source: made by the author based on the data sheets of online KAP (On-line Katasztrófavédelmi Adatszolgáltató Program [Online Disaster Management Data Program]) and alerts

Following the storm, a total of 746 alerts arrived at the operations control center of the county disaster management directorate. Out of the 746 alerts, a total of 449 interventions were carried out by the professional headquarters of Nagyatád, Marcali and Kaposvár, the local fire brigades of Böhönye, Tab, and Balatonboglár, as well as ten voluntary firefighting associations, which were commanded at the site (the ROPES of Berzence, Látrány, Törökkoppány, Csököly, Bodrog, Igal, Kaposvár, Görgeteg, Nágocs, Szőkedencs), in close cooperation with the partner organisations.

[14] Based on an interview with Lieutenant Firefighter Szabina Mihályka Bázelné, County Disaster Management Spokesperson, August 1, 2017.

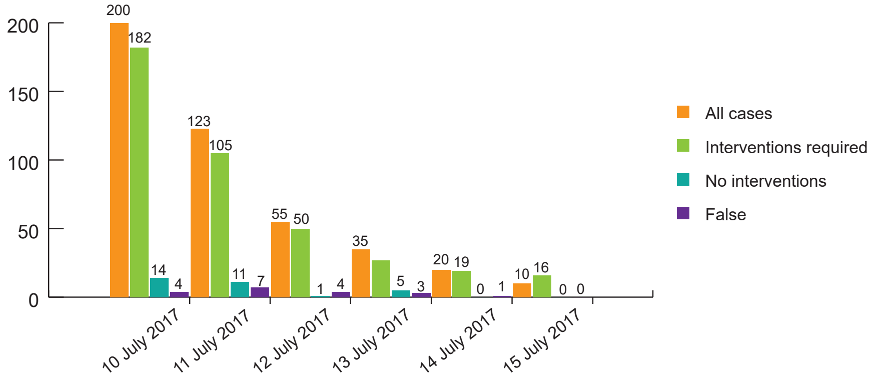

Figure 5. Accidents between July 10 and 15, 2017, broken down by day according to the methods of intervention
Source: made by the author based on the data sheets of online KAP and alerts

More than a hundred firefighters worked in Siófok and Balatonvilágos every day, while 314 reported incidents were eliminated in cooperation with the municipalities, the Hungarian Public Roads Ltd., the electricity supplier and property owners. There were several cottages where the squadrons worked all day, freeing the roofs from the weight of the fallen trees in half-meter pieces so as not to cause further damage to the buildings.

8. Conclusions

The primary purpose of this article was to present the complexity of damage events caused by extreme weather events through a concrete damage event. Having taken the research to an international level, he examined the main risk factors in the European Union from the point of view of civil protection and the events that have taken place in the world and the relationship between major accidents involving dangerous substances and natural hazards.

The research done in connection with Natech accidents (Natural hazard triggered technological accidents) found that at least five percent of serious accidents or breakdowns involving hazardous materials can be attributed to the occurrence of natural hazards.

According to research made by Munich RE NatCatSERVICE, it can be declared that natural disasters caused by extreme weather events have taken nearly a million lives since 1980 and caused losses of about $ 4.2 trillion. It can be stated that extreme weather events pose a great risk and challenge to mankind in terms of both human life and material damage.

On the territory of the European Union, extreme weather events are the main factors among the main risks identified in the countries participating in the Civil Protection Mechanism.

Larger ‘volumes’ of natural damages always make the author realise that it is not possible to fully prepare for them. Of course, one does not think about the intervention but the possibility of their occurrence. The mass damage event in Siófok also proved this claim, but the investigation revealed several other factors as well that increased the extent of the damage.

An embankment protects this section of the southern shore of Lake Balaton. The area in question (where the storm raged) lies on the aggradation between the shore and the railway, which used to be a part of the bed of Lake Balaton. Mostly black pines were planted to bind the upper layers of the soil in the aggradation area. Black pine is otherwise suitable for binding the top layers of the soil, and has been planted for this purpose in several places across the country. The tree roots grow in the upper soil layers and the tree very rarely grows main roots into the deeper layers. Presumably, the embankment soil proved to be a better, more nutrient-rich crop layer, as the black pines planted here reached a height of 30 meters in some places, unlike the national average height. Thus, black pine trees have outgrown the buildings in their surroundings, providing more surface space for the raging storm. The prevailing, north-west wind direction made the situation even worse since the trees lay in the storm's way.

The high built-up percentage of the plots cannot be classified on the positive side either, and, with a slight exaggeration, the planted trees were on each other's tops and backs. Effects and counter-effects led to a mass damage event: A stormy wind came from south-west, from the Hungarian–Croatian border. In some places the wind exceeded 150 km/h. The black pines planted on the shores of Lake Balaton in Siófok outgrew their surroundings and developed according to another wind direction.

Their weak roots allowed the storm to cause havoc. Trees planted close together also increased the damage, not to mention the densely built-up buildings. Unfortunately, on the principle of the domino effect, falling trees uprooted several more storm-resistant trees and covered the buildings with them, causing more damage.

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