

A SCOURGE LIKE NO OTHER

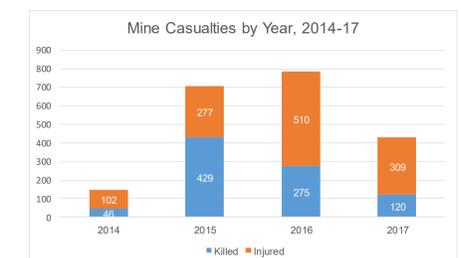
ASSESSING LANDMINE VULNERABILITY AND RISK IN EASTERN UKRAINE

BACKGROUND

Since the onset of war in Eastern Ukraine in 2014, monitoring groups have struggled to maintain a clear picture of the damage caused by war and the changing vulnerabilities for residents who have not been able to relocate.

The OSCE and Human Rights Watch have reported the use of cluster munitions and landmines by government forces and the self-declared, Moscow-backed, Donetsk and Luhansk People's Republics. In less than five years, Ukraine has become one of world's heaviest mined countries. Today the HALO Trust confirms that Ukraine led the world in unexploded ordnance (UXO) accidents for three years running. Over 1,800 mine casualties were recorded 2014-2017, and mine-related injuries represent two-thirds of all child fatalities in the region.

This project aims to determine the areas of Eastern Ukraine most at risk by war, including from both conventional weapons and UXOs through a geospatial vulnerability assessment and consider where demining activities may have the greatest societal impact.



METHODOLOGY

To find the most sensitive areas, separate risk and vulnerability assessments were created of the Donetsk and Luhansk Oblasts, the two regional Ukrainian administrative units which comprise an area known collectively as *Donbas*. Raster analysis techniques were applied to four separate vulnerability variables: population density, proximity to schools, proximity to roads, and distance from hospitals and clinics. Euclidean Distance was applied to separate transportation, education, and health shapefiles – sourced from OpenStreetMap – and the Re-classify tool assigned all four vulnerability factors scores from 1-5. The Raster Calculator overlaid these rasters together to create a composite score.

Separately, this process was carried out for risk factors. As the war in Donbas is ongoing and fairly young, comprehensive UXO data does not yet exist. However, the HALO Trust, an international demining agency, has published Rapid Assessment shapefiles which were utilized to determine both confirmed and potential minefield locations. To support this data, data was referenced from the Uppsala Conflict Data Program (UCDP), which has geotagged war events since the beginning of the war. By the estimate of the Ukrainian government, only 15-20% of UXOs are landmines; by considering the density of more conventional forms of warfare, an estimate can be made of where explosive remnants of war (ERWs) are likely to be. The Kernel Density tool was applied to this data to create rasters which were also reclassified as 1-5 scores indicating density of risk. A risk composite was generated through an identical process as vulnerabilities.

Together, these rasters were overlaid, with risks receiving a 2.5x weight to vulnerabilities; ultimately, there is no greater indicator of areas at risk to mines than proximity to weapons activity. This composite raster was reclassified once again, considering the distribution of the data, to separate the areas of high and most extreme risk and vulnerability. Finally, the Zonal Statistics tool was used to estimate the population and the areas where sensitivity is highest.

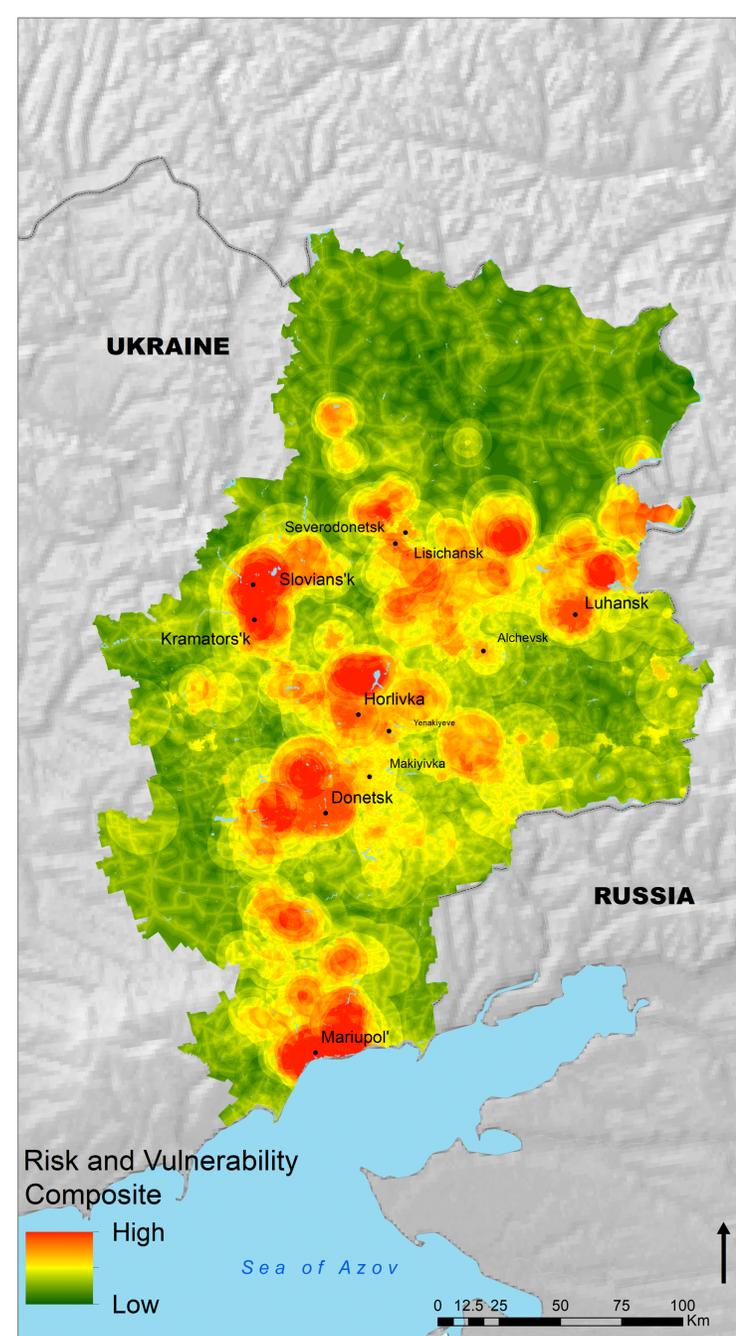
RESULTS AND LIMITATIONS

The results show a ring of high risk around the line demarcating government-controlled vs non-government controlled areas (NGCAs). The highest risk areas tend to correlate with densely populated areas where there has been significant recorded military activity since fighting began, particularly in the important industrial cities of Mariupol, Donetsk, Horlivka, Sloviansk, Luhansk, and Kramatorsk. Additionally, areas east of Lisichansk, and northeast of Luhansk show high scores, while there is slightly less vulnerability to the population.

Profile	Area (Km ²)	Pop. at Risk (Est.)
Low Risk & Vulnerability	49,351	2,028,908
Elevated Risk & Vulnerability	3,558	1,336,074
Highest Risk & Vulnerability	726	392,830

The analysis estimates that over 392,000 residents live in these zones classified as Highest Risk & Vulnerability, an area covering 726 km², while another 1.3 million live in an elevated risk and vulnerability zone covering 3,558 km². It is recommended that demining activities prioritize these most sensitive areas to generate the greatest humanitarian and economic impact. The scale of the UXO problem in Ukraine has not yet been fully understood, but as international agencies such as the OSCE and the HALO Trust, among others, work together to survey the territory, special attention should be given to areas where significant mine activity could be expected, and where their clearance would be most beneficial.

This analysis is limited by a lack of publicly available data from non-government controlled areas. Furthermore, the displacement of over 1.2 million Ukrainians, and subsequent lack of census data has made population analysis difficult.

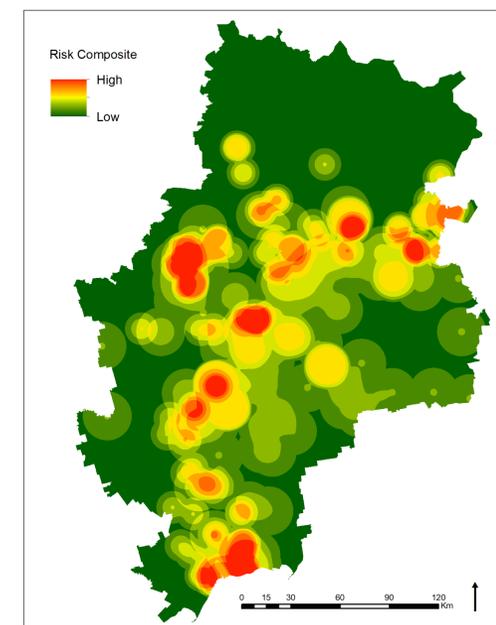
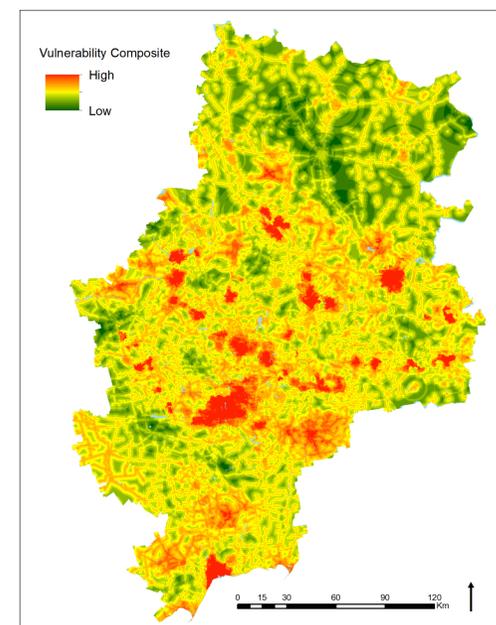
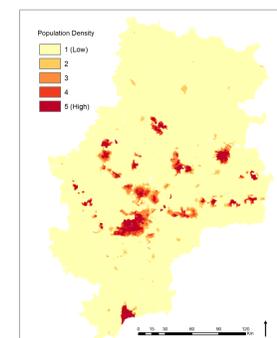
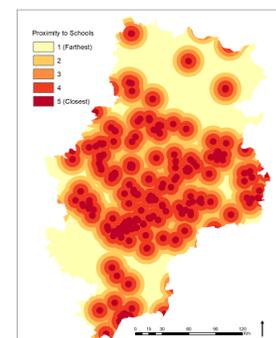
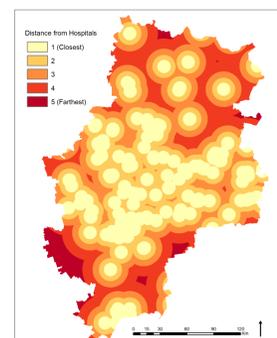
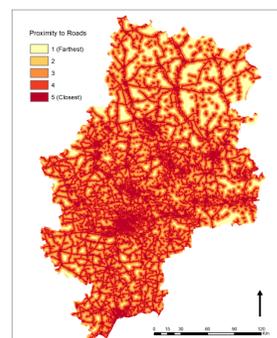


SOURCES

Landmine and Cluster Munition Monitor (2018), OpenStreetMap (2018), Uppsala Conflict Data Program (2018), HALO Trust (2018), EU Civil Protection and Humanitarian Operations (2017), WorldPop, ESRI, UN Humanitarian Data Exchange, International Committee of the Red Cross



VULNERABILITY FACTORS



RISK FACTORS

