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ON THE COVER
Drones at work in humanitarian mine action, Sahara Desert, Chad. To learn more, see page 55.
Photo courtesy of John Fardoulis, Mobility Robotics.

COMING IN ISSUE 24.3 | SPRING 2021

- **COVID-19 and HMA**
- **Battle Area Clearance/Urban Clearance**
- **Prosthetics**
- **Mobile and/or Efficient Data Collection Methods**
- **Ukraine**
- **Environmental and Weather Challenges of HMA/CWD**
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The Journal of Conventional Weapons Destruction is a professional trade journal for the CWD community, including but not limited to humanitarian mine action, physical security and stockpile management, small arms and light weapons, and other related topics. It is a forum for best practices and methodologies, strategic planning, risk education, and survivor assistance.

The Journal Editorial Board reviews all articles for content and readability, and reserves the right to edit accepted articles for readability and space, and to reject articles at will.

Authors who submit articles to *The Journal* are expected to do so in good faith and are solely responsible for the content therein, including the accuracy of all information and correct attribution for quotations and citations.

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A NOTE FROM INTERIM DIRECTOR SUZANNE FIEDERLEIN, PH.D.

As we approach the end of 2020, I hope this finds you and your loved ones safe, healthy, and well. It has been an unusual time for us all, with so many of our events held virtually, including the eighteenth meeting of the States Parties to the APMBC, the Second Review Conference of the Convention on Cluster Munitions, and the Countering Explosive Threat and Demining Symposium, all of which I had the opportunity to attend remotely. In a time of global upheaval, I am even more convinced of the importance of information exchange as we share our organizational expertise to broaden humanitarian assistance despite COVID-19.

In this issue of *The Journal*, we feature articles on a broad range of topics that signify the outstanding work HMA organizations foster in spite of the logistical, organizational, and funding challenges our sector faces at this time.

Research and Development and Editorial. Presenting their award-winning Odyssey2025 Project, Mobility Robotics and Humanity and Inclusion (HI) discuss their use of drones and airborne IR thermography to find buried landmines under field conditions in the deserts of Chad. Additionally, Mobility Robotics and HI argue in their editorial the need for researchers to work in conjunction with HMA practitioners, highlighting the importance of maximizing the impact that research funding has on communities with explosive contamination.

Empowering Local Capacity in HMA. UNMAS DRC present on their weapons and ammunition management work to curb the proliferation of weapons and improve security in numerous regions. We also hear from the Geneva International Centre for Humanitarian Demining (GICHD), Cambodia Mine Action Authority (CMAA), and Norwegian People's Aid (NPA) on their joint work to mainstream gender and diversity capacity among national mine action authorities.

Balkans. The Marshall Legacy Institute (MLI) and ITF-Enhancing Human Security (ITF) present on their Mine Free Sarajevo project, utilizing land release methodology to clear nearly 8 million sq m of contaminated land in Sarajevo and its surrounding municipalities, while The HALO Trust (HALO) discusses their weapons marking and tracing program in Bosnia and Herzegovina, highlighting the collaboration between the European Armed Forces in Bosnia, Pryor Marking, and the European Force in Bosnia.

Information Management. From iMMAP, we feature two articles focusing on their information management systems and tools in use in northeast Syria and Iraq, highlighting their ability to improve decision-making processes, quality, and information sharing among actors working in the contaminated regions.

HMA and COVID-19. From the Mine Action Support Group (MASG), Wolfgang Bindseil and Ian Mansfield present a donor's perspective on HMA funding and operations against the backdrop of the global pandemic. Facing significant challenges to funding and operations, the authors present the challenges discussed during a May 2020 meeting.

IMAS. Roly Evans from the GICHD reviews the changes and improvements to IMAS 10.60 Safety & Occupational Health—Investigation and Reporting of Accidents and Incidents. Key updates include the importance of evidence in reporting, simplification of the reporting timelines, and a new system of different investigation levels, among others.

Explosive Ordnance Risk Education (EORE). The Swiss Foundation for Mine Action (FSD) and the Office of the High Commissioner for Peace - Descontamina Colombia reviews their study of EORE activities between 2012 and 2019 in Colombia.

Historical Perspective. And from CISR's former director, Dr. Ken Rutherford, we have an article that looks at the use of landmines during the American Civil War, following the publication of his book, *America's Buried History: Landmines in the Civil War.*

In looking toward the Spring issue of *The Journal*, we are soliciting for a broad range of topics including Ukraine, the environmental challenges of HMA, battle area and urban clearance, the use of prosthetics, mobile and efficient data collection methods, and commercial off-the-shelf tools for mine action, among others. We also want to continue to hear how organizations have adapted their operations throughout the global pandemic. For more information, please see *The Journal's* Calls for Papers at https://www.jmu.edu/cisr/journal/cfps.shtml.

In closing, I wish you a safe and healthy 2021, one filled with more of the personal interactions that nurture us and that we all have missed in 2020.

Suzanne

IN THIS ISSUE:

TIME TO STEM LIGHTWEIGHT APPROACHES AND FOCUS ON REAL MINEFIELD DATA?

By John Fardoulis [Mobility Robotics] and Xavier Depreytere [Humanity & Inclusion]

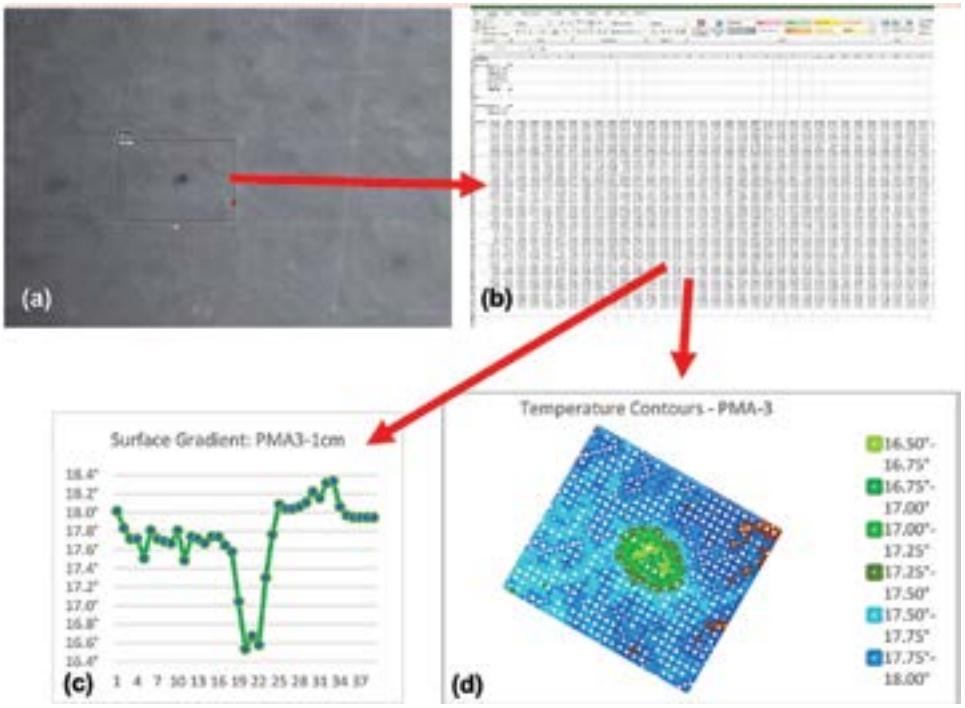

Figure 1. An example of thermal/LWIR data from real landmines in the desert captured by the author: (a) is a thermal image straight from the sensor; (b) is data exported, with every pixel indicating a temperature; and (c) and (d) are visualizations of the surface temperature anomaly created by a buried PMA-3 landmine. More research projects should be capturing field data like this.
All graphics courtesy of the authors.

Over the past twenty years thermal/long-wave infrared (IR or LWIR) imaging, also known as thermography, has progressed insufficiently from research to field deployment in the humanitarian mine action (HMA) sector. While preparing for airborne IR thermography fieldwork as part of the Odyssey2025 Project between Humanity & Inclusion and Mobility Robotics in Chad, a comprehensive literature study conducted by the authors to determine what was state-of-the-art knowledge indicated this trend. Background knowledge for this article is based on lessons learned during airborne thermal/LWIR imaging work from small drones in desert minefields during October 2019. Experience gained in locating temperature anomalies allowed authors to identify the position of thirty-year-old legacy buried anti-personnel and anti-tank landmines at in-situ minefields using airborne IR thermography.

From the literature reviewed, the authors identified a disconnect between thermography-related research projects and practical, real-world HMA operations. The literature review also indicated that research topics have been duplicated without sufficient evidence to indicate if buried landmines could (or could not) be located under actual minefield conditions using IR thermography as an enhanced survey technique.

BACK TO THE FUTURE

IR thermography technology has been available for many decades, with a "think we can" summary published by Bowman et.al[1] in 1998 explaining the potential for the use of airborne cameras to identify color or temperature differences of the ground to locate surface and buried landmines. Over two decades later, similar research articles covering known techniques continue to appear without substantially progressing usable research, and not moving forward to practical next steps.

DEFINITION OF THE "FIELD"

Ambiguity exists regarding how to define the *field*, with some researchers' outdoor tests at university or government/military facilities labelled as controlled field tests. However, HMA considers field operations as those where real minefields exist or are suspected to exist in situ. Part of a Cambridge Dictionary definition states the field as "a place where you are working or studying in real situations, rather than from an office, laboratory, etc."[2]

Our definition of a controlled (static) field trial is the use of production landmines with explosives intact but rendered safe with detonators removed and buried within a 100 km radius of actual minefields. The reason for a 100 km radius is to closely match natural (geophysical) environmental and weather variables at in-situ minefields. Tests

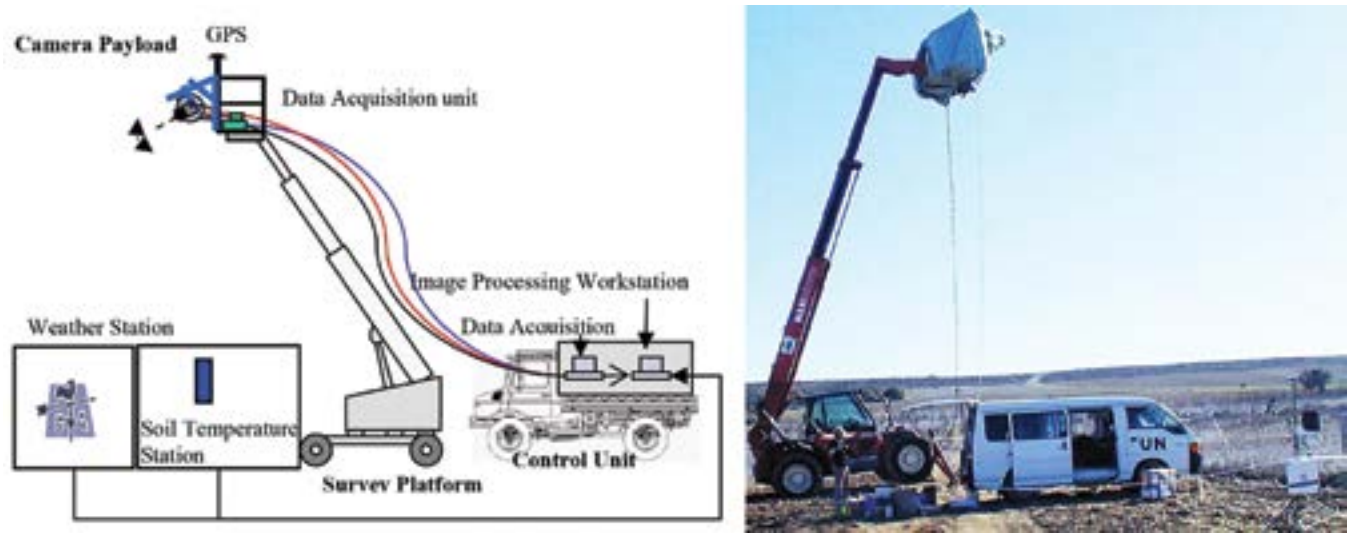

Figure 2. The CLEARFAST thermal/LWIR imaging system over a real minefield in 2005, a precursor to drone capabilities today.

at a university or government site in countries without real minefields should be identified as occurring at an *outdoor laboratory*, not field tests or field trials. With similarities to the concept of technology readiness levels, Table 1 provides a summary of research milestones (or levels of proof) required to determine if IR thermography might or might not be feasible at specific legacy minefield locations under actual field conditions. The outdoor laboratory trial ultimately has limited applications in the path to field deployment.

LACK OF VALIDATION

An apparent trend in thermography research projects is not progressing further than outdoor laboratory trials to later steps in the field (Table 1). Furthermore, Table 2 provides a summary of the literature examined by the authors, a review of forty-seven articles published over the last twenty-five years that discuss a range of elements affecting the feasibility of locating buried landmines using thermography. A further six IR thermography research articles were reviewed by Makki et.al[3], bringing the total to fifty-three articles reviewed. From the literature examined, only one project progressed to a static field trial. Column headings in Table 1 show the different steps in field research/validation that establish enough proof for HMA actors to gain confidence and justify investing in such a technology. From a practical perspective, HMA actors may view many of the articles reviewed as outputs from obscure academic experiments, lacking real-world credibility from a field perspective. Many of these articles were published in specialized academic journals, often intended for a limited audience of niche subject-matter experts, who fall short of connecting with real-world HMA practicality, and without the authors' understanding the larger picture.

Across the literature reviewed, the only project that captured IR thermography data at a real minefield was by Cremer et.al.[4], during 2005 in Cyprus. In a later article, Thành[5] from Cremer's team stated that thermography research projects were being run without any real minefield data. Their solution was to deploy a cherry picker-style crane and United Nations minivan to collect data under actual field conditions in Cyprus. In 2005, deploying a large mechanical boom was the best possible method for mounting heavy sensors at an elevated position next to a minefield. The boom was connected to a minivan housing computing equipment that operated within the data processing constraints of the time.

Data captured was then used by the same group to develop impressive numerical models regarding how buried landmines interacted with the environment, Thành et al.[5,6,7] These articles discuss how weather and environmental factors can affect the variability of results, elements that affect the strength and timing of temperature anomalies from buried landmines, mathematical modelling of factors in play, automated data processing, sensors, and the complexity of the underlying science. Learning from such work should be a starting point for any research into IR thermography for locating buried landmines because of the comprehensive approach undertaken. A point of difference is that Cremer and Thành et al.

Activity	Storyboards	Simulations & Indoor Trial	Outdoor Laboratory Trial	Static Field Trial	Initial Field Trial	Field Validation	Field Deployment at Scale
Number of Real Mine Field Locations	None	None	None	Low	Low	Medium-High	Very High
Temporal Resolution of Real Mindfield Data	None	None	None	Medium-High	Medium	High	High
Accurate Weather Variables	None	Low	Low	High	High	High	High
Accurate Environmental Variables	None	Low	Low	High	High	High	Very High
Production Landmines	None	None	None	High	High	High	Very High
Movement	None	Low	High	Low	High	High	Very High
Optimal Operating Parameters	None	Low	Low	Low-Medium	High	High	High

Table 1. Level of real-world proof (legacy in-situ minefields).

A 2019 upgrade to the system appearing in Figure 2. Here, the author uses small drones to fly thermal/LWIR sensors over legacy desert minefields in Chad. Sadly, real-world thermal/LWIR data has been scarce since 2005.

also ground-truthed theoretical results against in-situ data recorded at real-world minefields.

Since 2005, computing/processing power has increased exponentially and sensors have grown smaller, to the point of fitting in the palm of your hand. Deployment of thermal/LWIR sensors over minefields became easier around seven years ago, when miniaturized units could be flown on small drones. However, articles continue to appear without any field data.

A DISCONNECT IN THE SECTOR?

Let's face it, setting up a sandpit at a university or government facility for outdoor laboratory trials is not very difficult. However, there are challenges in travelling to locations where legacy minefields exist, especially places of most interest for IR thermography—arid locations. Even so, this is not a valid excuse for a disconnect between research projects and HMA.

A more holistic approach would be to include at least one HMA operator in the feedback loop and, ideally, for a national authority/mine action center (MAC) to share priorities for each country of interest. The best approach is to gain specific information: coordinates for the location(s) of minefields, as well as a list of actual landmine models found in these locations. For example, certain minimum metal anti-tank landmines could be prioritized along extensive stretches of closed roads in Afghanistan. Collaborating with HMA operators and MACs is vital in determining priorities. Linking practical innovation to beneficiary needs is how to make a difference in post-conflict communities affected by residual contamination, rather than conducting research purely for academic purposes.

RED FLAGS

Hinting at a lack of understanding by researchers, the first red flag often observed is with the use of the words *detection* and *survey*. Both words carry very specific and different connotations regarding risk and operational parameters under international and national mine action standards, i.e., in HMA, the phrase "landmine detection" means a near 100 percent detection rate with very few false alarms. Misuse of terminology can indicate signs of both a lack of understanding regarding HMA processes and a lack of collaboration with HMA actors. The term survey is more general and does not always infer a near 100 percent detection rate, e.g., non-technical survey.

The second red flag is a lack of and/or questionable data. The first test should involve the following questions: Which particular landmine model(s) were studied, and in what specific location(s)?

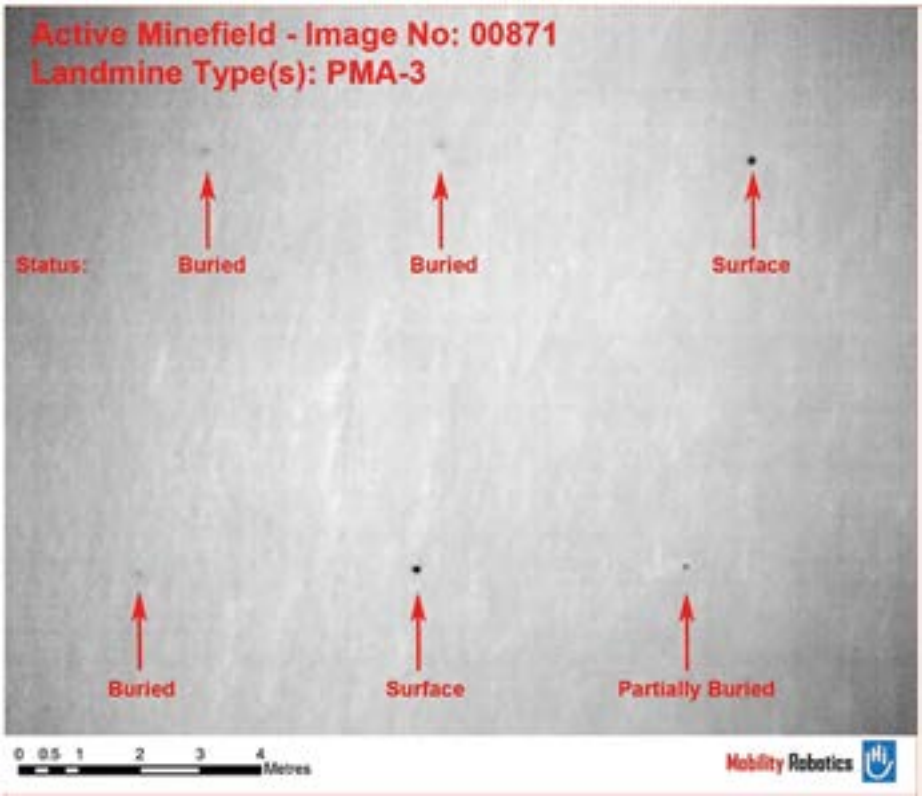

Figure 3. Thermal/LWIR image of two rows of active PMA-3 landmines in-situ, captured by the author thirty years after the conflict.

Title	Topic Relating to Buried Landmines	Publication Year
Characterization of diurnal and environmental effects on mines and the factors influencing the performance of mine detection ATR algorithms[i]	Surrogate design, time of day/night (diurnal cycle)	1995
Improved Landmine Detection Capability (ILDC): Systematic approach to the detection of buried mines using passive IR imaging[ii]	Route clearance using LWIR on ground vehicles to find buried landmines	1996
Hyperspectral infrared techniques for buried landmine detection[iii]	Soil and sensors	1998
Thermal Imaging for Landmine Detection[iv]	Microwave heating of the surface	1998
Sophisticated test facility to detect land mines[9][v]	Outdoor laboratory design	1999
Impact of soil water content on landmine detection using radar and thermal infrared sensors[vi]	Sensors and soil/sand/ground	2001
Modeling transient water distributions around landmines in bare soils[vii]	Soil and water transport	2001
Modeling transient temperature distributions around landmines in homogenous bare soils[viii]	Soil and environment	2001
Measurements and modeling of soil water distribution around landmines in natural soil[ix]	Laboratory tests, simulations, surrogate landmines	2001
An analysis of thermal imaging method for landmine detection using microwave heating[x]	Laboratory tests, heating and cooling	2001
Land mine detection in bare soils using thermal infrared sensors[xi]	Ground water/moisture time of day/night (diurnal cycle)	2002
CNN-based 3D thermal modeling of the soil for antipersonnel mine detection[xii]	Numerical modelling, deep learning	2002
Detecting and locating landmine fields from vehicle and air-borne measured IR images[xiii]	Image processing, deep learning	2002
Image Processing-Based Mine Detection Techniques: A Review[xiv]	Image processing, deep learning	2002
Thermal Analysis of Buried Land Mines Over a Diurnal Cycle[xv]	Time of day/night (diurnal cycle)	2002
Littoral Assessment of Mine Burial Signatures (LAMBS) – Buried Land Mine/Background Spectral Signature Analyses[xvi]	Sensors, spectral signatures, sand, soil, weather and environment	2003
Fusion of polarimetric infrared features and GPR features for landmine detection[xvii]	Sensor fusion	2003
Effects of Thin Metal Outer Case and Top Air Gap on Thermal IR Images of Buried Antitank and Antipersonnel Land Mines[xviii]	Numerical simulations	2003
Soil effects on thermal signatures of buried nonmetallic landmines[xix]	Soil and environment	2004
Controlled field experiments of wind effects on thermal signatures of buried and surface-laid landmines[xx]	Impact of wind	2004
A controlled outdoor test site for evaluation of soil effects on landmine detection sensors[xxi]	Outdoor laboratory design	2004
A review of satellite and airborne sensors for remote sensing based detection of minefields and landmines[xxii]	Airborne sensors on manned aircraft, ground sign indicators	2004
Experiments of thermographic landmine detection with reduced size and compressed time[xxiii]	Laboratory heating tests	2004
Improved Thermal Analysis of Buried Landmines[xxiv]	Mathematical modelling & deep learning	2004
Parameterisation of non-homogeneities in buried object detection by means of thermography[xxv]	Laboratory tests	2004
DSTO Landmine Detection Test Targets[xxvi]	Dummy/surrogate landmine design	2005
Stand-off Thermal IR Minefield Survey: System concept and experimental results[xxvii]	Real minefield data, deep learning	2005
Strength of landmine signatures under different soil conditions: implications for sensor fusion[xxviii]	Complexity of soil properties	2005
Analysis of a thermal imaging method for landmine detection using heating of the sand surface[xxix]	Surface heating	2005
Thermal infrared identification of buried landmines[xxx]	Soil, sensors, modelling	2005
Numerical and Experimental Investigation of Thermal Signatures of Buried Landmines in Dry Soil[xxxi]	Soil and sensors	2006
Finite-Difference Methods and Validity of a Thermal Model for Landmine Detection With Soil Property Estimates[xxxii]	Sophisticated modelling, including the use of real minefield data from [3]	2007
Image processing of landmines[xxxiii]	Sensor capabilities for route clearance	2007
Heat Transfer for NDE: Landmine Detection[xxxiv]	Deep learning	2007
A thermal infrared hyperspectral imager (tasi) for buried landmine detection[xxxv]	Manned aircraft deployment of sensors	2007
Signature Evaluation for Thermal Infrared Countermine and IED Detection Systems[xl]	Computer simulations	2008
Modeling of TNT transport from landmines: Numerical approach[xxxvii]	Simulations, transport of landmine chemical signatures	2009
FPGA computation of the 3D heat equation[xxxviii]	Hybrid hardware/software, infrared thermography	2010
Detection and characterization of buried landmines using infrared thermography[xxxix]	Image processing, numerical modelling, heat equation	2011
Passive infrared technique for buried object detection and classification[xl]	Simulations & numerical modelling	2011
Role of moisture and density of sand for microwave enhancement of thermal detection of buried mines[xli]	Modelling & influence of ground moisture/water content	2012
Remote detection of buried land-mines and IEDs using LWIR polarimetric imaging[xlii]	Sensor design	2012
Soil moisture and thermal behavior in the vicinity of buried objects affecting remote sensing detection: Experimental and modeling investigation[xliii]	Soil moisture, temperature transfer and environment	2013
Experimental Validation of an Active Thermal Landmine Detection Technique[xliv]	Heating tests and laboratory design	2014
Buried and Surface Mine Detection From Thermal Image Time Series[xlv]	Time of day/night (diurnal cycle), deep learning	2017
Diurnal Thermal Dormant Landmine Detection Using Unmanned Aerial Vehicles[xlvi]	Time of day/night (diurnal cycle), small drones, surrogate objects	2018
Multi-Temporal IR Thermography For Mine Detection[xlvii]	Time of day/night (diurnal cycle)	2019

Table 2. Table representing a summary of twenty years of research using thermography to locate buried landmines.

Storyboards, goals, or outdoor laboratory tests with irrelevant buried objects tested in completely different weather and geophysical environments from actual field locations do not prove that you could employ the same methods and find buried landmines in specific post-conflict locations. Field data that holds up to scrutiny is needed to provide confidence in the real world.

A third red flag involves preparedness so as not to duplicate previous research. Questions to ask include

- Has a comprehensive literature review been performed?
- What can researchers learn from previous efforts and how can these be incorporated to further knowledge?
- Have researchers worked in the field? Can someone be an "expert" and innovate without ever visiting a minefield?

Understanding practical real-world requirements and challenges is essential. How is research novel? In what ways can it overcome problems where similar previous research failed to reach field implementation? How transferrable are findings from pre-testing at outdoor laboratories to a particular post-conflict location? Visiting minefields helps researchers achieve a practical understanding of what the real world looks like. Many complex variables are actively at play, and omitting just one can result in a major research floor. Minefield visits can reveal quirks associated with the types of contamination present: the terrain, natural environment, and weather conditions in a specific location—these may not be clear from a desktop study. Claims are sometimes made that a certain research project will revolutionize HMA, but can this be said without practical empathy regarding how demining and survey staff work in each country, analogous to the phrase, "walk a mile in his shoes?"

GARBAGE IN, GARBAGE OUT?

Popular topics currently include the use of drones, and/or automated data processing, often both together. Computer algorithms need comprehensive training data to be effective, often thousands of data points as a minimum. Without data from real minefields, one could ask if the output might follow the old computing saying "garbage in, garbage out," particularly if data does not contain accurate landmine anomaly signatures. How could one defend the validity of outputs without any ground truthing under actual field conditions? See the second flag in this regard.

CONFIDENCE IS ESSENTIAL IN A RISK-BASED CULTURE

And finally, no matter how sophisticated the research, can there be proof without field trials and validation? How can researchers be sure they have not missed a variable that renders their work untenable? Theory and hypothesis stacked upon theory and hypothesis does not mean that research will work in actual field conditions. Legacy minefield data is the end point, or perhaps it should be the starting point?

Therefore, the importance of *real* fieldwork, the significance of undergoing a literature review before starting your own research, and the need for researchers to work in conjunction with HMA operators are all essential, not only to those working in HMA, but—more importantly—to the post-conflict communities the sector strives to help.

Pre-requisites for research projects should include the following:

- Researchers meet with HMA operators and MACs to produce a list of the most important priorities for an individual country.
- Provide funding for an HMA technical adviser to help mentor a project.
- Visit the field during initial scoping stages of each project and report back regarding how real-world conditions will affect methodology and to determine where field trials will take place.
- Concentrate on specific landmine models and practical HMA operating requirements.
- Implement a feedback mechanism to gain HMA scrutiny and peer review regarding if research proposals are novel, practical, and have the potential for real-world impact.

Ideally, donors and research councils should mandate the pre-requisites mentioned before granting funding and assess projects based on practical outcomes for affected communities, post-project completion.

The only way to provide confidence for such a risk-averse sector such as HMA and to increase the uptake in the use of IR thermography in arid environments is with solid proof, which has been very light over the last two decades. Perhaps the impact of this editorial might be to stem lightweight approaches that continue today, foster practical collaboration with HMA actors, and divert energy toward capturing real minefield data.

See endnotes page 64

THANKS AND ACKNOWLEDGEMENTS

The Belgian Directorate-General for Development funded the Odyssey2025 Project. Their gracious support helped to achieve many milestones, particularly furthering knowledge in methods regarding how to use small drones for the location of buried landmines.

John Fardoulis
Mobility Robotics

John Fardoulis is a scientist, remote-sensing practitioner, aerospace engineer, and "methodology designer." He was the specialist in small drone research, fieldwork, and training on the HI Odyssey2025 Project in Chad. Having worked in HMA, academia, and as a commercial drone service provider (with CAA accreditation in the U.K.), he is in a unique position to add value at every level of research and small drone operations. Fardoulis has a Bachelor of Business from the University of Western Sydney (AU) and a MSc in Aerospace Engineering from the University of Bristol (U.K.).

Xavier Depreytere
Humanity & Inclusion

Xavier Depreytere joined Humanity & Inclusion (HI) in 2018 after working in industry as an automation project engineer. He was in charge of the strategy and coordination of the HI Odyssey2025 Project in Chad. Xavier holds a masters in biosystems engineering from the University of Mons, Belgium.

EDITORIAL

MINE ACTION IN TIMES OF COVID-19: A DONOR'S PERSPECTIVE

By Wolfgang Bindseil and Ian Mansfield [Mine Action Support Group]

Screenshot from a UNICEF presentation given on COVID-19 during a video call with participants.
Image courtesy of the authors.

THE ROLE OF MINE ACTION DONORS

Since the beginning of humanitarian mine action (HMA) in the late 1980s, the sector has relied heavily on donor support. Financial assistance continues to be the most obvious form of support for national authorities and mine action operators. Donor support to HMA has mainly remained in the range of US$450–500 million per year for the past decade, peaking at almost US$700 million in 2017 as donors responded to the legacy of ISIS in the Middle East.[1] This has been a substantial commitment by any measure. The funding is provided through various channels, such as the Organization of American States and the Organization for Security and Co-operation in Europe, UN trust funds, ITF Enhancing Human Security, national authorities, or directly to (international) HMA nongovernmental organizations (NGOs) and other organizations like the International Committee of the Red Cross (ICRC) and the Geneva International Centre for Humanitarian Demining (GICHD). Donor funding covers the full range of HMA activities, including risk education, survey and clearance, stockpile destruction, victim assistance, advocacy, capacity building, and coordination.

Donors approach HMA in accordance with their own national strategies and priorities. A few donors view the landmine and explosive remnants of war (ERW) issue as purely humanitarian. Whereas some pursue it from a development perspective, others view activities through a stabilization and peace support angle or the promotion of international treaties as the most important factors. Several donors have published mine action strategies outlining their policies and priorities. These include the "Mine Action Strategy of the Swiss Confederation 2016–2022"[2] and the German "Federal Foreign Office Humanitarian Mine Action Strategy within the framework of Federal Government humanitarian assistance,"[3] both of which were finalized with the support of GICHD. Other donors use their broader humanitarian, development, or peace-building strategies to guide their HMA work.

In 1998, a core group of interested donors established an informal body called the Mine Action Support Group (MASG). Since its creation, the MASG has been an active forum for HMA donors and key partners to meet and discuss common issues. The MASG allows for an exchange between the HMA programs of the world's major donor

states about best practices and prioritization, coordination with UN agencies, and brings donors' attention to issues where support for HMA is particularly needed. The MASG now consists of thirty-three donors, along with invited external observers including the United Nations Mine Action Service (UNMAS), several international organizations, and academia. The MASG normally meets twice a year, once in the context of the Mine Action National Directors and United Nations Advisers' Meeting (NDM) in February, usually held in Geneva, and again in New York City in October at the time of the United Nations First Committee Session. The Chair of the MASG rotates every two years, and Germany assumed the Chair in January 2020.

Over the years, donors have also influenced the HMA sector in more ways than by just providing money. For example, MASG members have called for the development of common sector-wide standards (e.g., International Mine Action Standards), hosted technical workshops and training activities, and actively participated in international and national level meetings. Donors, like Germany, strive to be true partners in the HMA process and are invested in the outcomes and impacts to be achieved by their funding and other support. Thus, when the COVID-19 pandemic hit the world in late 2019, it not only impacted operators, international organizations, and national authorities, but also created new challenges for donors as well.

THE IMPACT OF COVID-19 ON MINE ACTION

The global pandemic has greatly affected the HMA sector. In some countries, programs are suspended, international staff repatriated, and local lockdowns continue to affect national staff. While operators must cope with restrictions, donors' strategic goals and objectives have to be revised as well. Staff protection became a particularly important issue. Working with beneficiaries in risk education or victim assistance, for example, creates new risks. Travel restrictions pose problems and incur cost increases for implementation, supervision, and coordination.

After receiving advice from donors, operators, and UNMAS regarding the need for an exchange on the unique situation brought about by COVID-19, Germany, as Chair of the MASG, arranged a global video conference on 27 May 2020. Over thirty donors participated in the conference, along with representatives from UN agencies, the GICHD, and four major international NGOs. The aim of the video call was to share experiences and challenges caused by COVID-19, particularly regarding the global pandemic's impact on HMA donors, and to pursue best practices in dealing with the situation.

During the video call, NGOs outlined the effects of COVID-19 on their HMA field operations. These included the temporary closing of work sites, travel restrictions placed on staff, social distancing requirements affecting work procedures, and the need for additional personal protective equipment (PPE). NGOs requested that funding levels be sustained through 2020 and 2021, and that donors support increased flexibility with grants and project implementation if their activities are affected by COVID-19. The use of HMA resources, which were idled by pandemic-related program restrictions, to address the pandemic in impoverished countries was also raised. Most participants feared that the growing prevalence of COVID-19 in countries with HMA activities would dramatically increase the uncertainty of planning, thus increasing financial risks for operators and donors. Appealing to those donors funding UNMAS programs with delayed or suspended activities to approve a flexible approach, UNMAS sought to retain minimum operating capacity that would allow programs to start back to work as soon as conditions allowed. Also wishing to retain both their contractors and the national staff who depend on their salaries in this uncertain time, UNMAS provided extensive, detailed information to several donors.

THE DONOR RESPONSE

For donors, the situation posed a dilemma, summed up by the representative of Finland, Ms. Anni Makelainen, in the following way:

It is difficult to find other projects (besides mine action) within our Ministry that are so heavily impacted by the restrictions of movement and face difficulties to re-orientate their projects, i.e., propose any alternative actions. Continuing to pay salaries while no results are produced is, of course, not an easy equation when it comes to our funding regulations. On the other hand, discontinuing funding and terminating the contracts of the local employees is not a very sustainable alternative either.

Several major donors—Finland, Germany, the United Kingdom, and the United States—had already provided early guidance to their partner organizations. The representative of the United Kingdom said that they had advised partners of the following broad principles:

We ask that partners make decisions based on the proportionality principle, and with a view to ensuring the safety of their staff. Partners should consult closely with local and national health authorities to ensure that their decision-making is in line with wider guidance and is not adversely affecting the local response to COVID-19. While adhering to the principles of doing no harm and staff safety, we encourage our implementing partners to continue delivering planned demining operations where possible and appropriate. Ultimately our partners are responsible for implementing projects as planned, and it is for our partners to decide whether it is appropriate to continue delivering demining work.

The United Kingdom then advised partners that they would guarantee the salaries of their demining staff for up to three months, including under forced lockdown.

Stanley L. Brown, the Deputy Assistant Secretary for Programs and Operations in the U.S. Department of State's Bureau of Political-Military Affairs, addressed the question of using HMA resources for other COVID-19 related activities, such as combining mine risk education with COVID-19 awareness raising activities or using idle demining vehicles for logistics or the movement of medical supplies to hospitals:

Where our implementers are still working, we have advised that their focus should and must remain on demining operations. That said, where host governments are requesting the use of HMA-funded assets, and it can be done in a reasonable and minimally disruptive manner, we will consider it. For example, in some cases we have authorized risk education and community liaison teams to simultaneously deliver COVID-19 related messaging while they go about their normal day-to-day work. Likewise, where demining operations have been suspended and we are still paying salaries

for workers and maintenance costs for vehicles, it may make good sense to employ these otherwise idle assets—with the proviso that those assets immediately be returned to demining operations as soon as operations can resume.

During the MASG video call, some common points emerged among the donor countries:

- As of mid-2020, no MASG member had cut funding to national authorities or NGO operators.
- Donors stressed the need for regular and proactive communications between them and their partners through virtual or other channels. Moreover, if there is a need to change original project documents, the funded partner should take the initiative and suggest alternatives.
- Donors showed flexibility in their responses if project targets could not be met or if project objectives needed to be adapted. However, none of the donors provided a blanket waiver to funded partners.
- Extensions to projects on a no-cost basis would generally be viewed favorably.
- Despite donors' flexibility and desire to avoid having operators return unused funding, donors stressed that, ultimately, they were bound by their own national financial regulations and that these would take precedence if required. In case of prolonged restriction on project activities due to COVID-19, difficult decisions would be unavoidable in the future.

Stakeholders agreed that the exchange was useful, and that COVID-19 will remain on the agenda of MASG meetings for the coming year.

THE FUTURE

Between May and August 2020, most mine action programs were expected to restart all or some of their operations. However, not all field or donor programs could be completed as planned and some of the projects had to be postponed. This is also true for Germany, which currently adapts its contingency planning on a weekly basis. Additionally, the evolving pandemic raised new concerns. In several areas, the pandemic had not reached its peak. Additionally, the imminent threat of a second or third wave lingers. In August 2020, the World Health Organization reported that the global rate of COVID-19 infections was still increasing, and that the pandemic may well be underreported in war-torn and mine-affected countries.

Regarding the German experience, the pandemic has indeed continued to influence the course of mine action projects. One operator in Iraq developed a trial package to implement RE via remote methods. The package includes videos with risk education modules uploaded on the internet and a methodology to support the risk education session through phone calls and sharing on e-materials. Remote QA tools were also developed. Several operators reported additional safety measures including the establishment of COVID-19 standard operating procedures (SOPs) that set out stringent hygiene procedures, holding meetings in virtual mode, introducing digital signatures to facilitate administrative processes, etc. Fortunately, but not necessarily expected, no further operations have been discontinued.

Obviously, the pandemic will continue to affect the work of donors and the MASG. This will be felt not least in the organization of conferences, like the second regular MASG meeting, which was held virtually in October 2020). Here, like in other areas of HMA, we will continue to improve our ability to cope better with current and emerging challenges.

Finally, because of COVID-19, the world is dealing with significant socioeconomic impacts of the pandemic and increased humanitarian needs in many regions, which likely will affect some donors' ability to provide new funding. Thus, HMA will face increased competition from other humanitarian initiatives. The pandemic will also therefore impact the ability of HMA to contribute to the fulfillment of the Sustainable Development Goals (SDGs), at least in the near term.

The authors hope that mine action donors remain committed to funding HMA as they have done for the past twenty years. In a broader context, a statement by the GICHD and the international NGOs summed up the current situation:

We understand that the COVID-19 pandemic is bringing about formidable new challenges both at the level of public health and economy resilience, nationally and globally. Against this background, it is our sincere hope that ways will be found for the mine action sector not to be left behind. We are convinced that mine action continues to play a key role towards our common goal of a world in which human suffering is prevented and mitigated, and no one is left behind.

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Wolfgang Bindseil
Chair of the Mine Action Support Group

Wolfgang Bindseil, Chair of the Mine Action Support Group since January 2020, is the Head of Division for Humanitarian Assistance (Regional Policy and Operation), including Humanitarian Mine Action, at the German Federal Foreign Office. On his previous post, Bindseil served as Minister-Counsellor at the German Embassy in Kyiv; former positions include Deputy Head of the Conventional Arms Control Division (2011–2015), Desk Officer for Russian Foreign and Security Policy (2009–2011), Desk Officer for Resource Planning (2006–2009), Press Secretary at the German Embassy in Moscow (2003–2006), and Political Secretary at the German Embassy in Cairo (1999–2003). He has a degree in electrotechnical engineering from Rheinisch-Westfälische Technische Hochschule Aachen (1993) and in Economics from Universität Hagen (2000).

Ian Mansfield
Secretariat of the Mine Action Support Group

Ian Mansfield works as a mine action consultant and has been the secretariat of the MASG since 2011. Previously he was the Deputy Director of the GICHD and the team leader of the United Nations Development Programme Mine Action Team in New York. Earlier, he was the UN mine action program manager in Afghanistan, Laos, and Bosnia and Herzegovina. In 2017, he published a memoir called *Stepping into a Minefield.*

Covid-19 illustration courtesy of the CDC.

OPERATIONALIZED MANAGEMENT INFORMATION SYSTEMS IN IRAQ'S DMA

By Mark Steyn and Arie Claassens [iMMAP]

Figure 1. RMAC-S area of responsibility.
Figures courtesy of Mark Steyn.

The Republic of Iraq remains severely contaminated with explosive ordnance (EO) according to the *Landmine and Cluster Munition Monitor* report 2019.[1] Located in southern Iraq, the Iraq Directorate of Mine Action's (DMA) Regional Mine Action Center South's (RMAC-S) area of responsibility contains the most contaminated area in Iraq in terms of surface area. The region's hazard areas recorded in the national mine action database (IMSMA) stood at 1,592 sq km by mid-July 2020, with the Basra Province alone containing 1.27 billion sq m of hazard area.[2] This contamination predominantly originates from various armed conflicts in the region, ranging mostly from the Iran-Iraq War in the 1980s to the 2003 Iraq War.[1] The region has seen relatively little conflict with Islamic State of Iraq and the Levant (ISIL), which bodes well for regional security but means funding for conventional minefield clearance is limited.

From a natural hazard perspective, the region is exposed to a range of natural and human-induced disasters, e.g., droughts, floods, sandstorms, desertification, and various epidemics. Compounding the situation is the country's poor economic situation, infrastructure, and unreliable internet connectivity. In addition to navigating the contamination hazards mentioned previously, RMAC-S is tasked with prioritizing land release activities based on, *inter alia*, the socio-economic status, population vulnerability, and development sectors' activities that are restricted by the hazardous areas within each

district. The presence of minefields in the region's large oil fields, on which the government relies heavily, further hampers the effective management of mine action resources available to RMAC-S.

ROLE OF MANAGEMENT INFORMATION SYSTEMS

Timely access to relevant information is a key enabler for effective decision-making in any organization and even more so when these decisions affect lives and livelihoods. Since 2004, iMMAP has supported and developed the humanitarian mine action (HMA) program's information management (IM) systems, delivered capacity building activities and facilitated coordination on IM, planning and prioritization between the DMA and other HMA actors in Iraq. Balancing the access restrictions and security requirements imposed by the government on the national mine action database contents, DMA's activities created an array of information products that provided decision makers with easier access to data subsets, assisting with data analysis and the contextualization of the hazard areas. The previous system resulted in delayed responses from fully-taxed personnel when staff from RMAC-S operations are met with urgent requests for planning or mine action tasks submitted by implementing partners. The shortfalls of the national budget contribute to the difficulty of retaining skilled national IM staff, complicating the DMA's operating capacity, and further delaying the output of (paper-based) field report submissions stemming from the problematic infrastructure.

To overcome the inherent inefficiencies related to complex data structures, data formats, resolution, and limited IM staff availability, RMAC-S' management committed to the co-development and subsequent use of a common operating picture tool for regional use by the RMAC-S operations department. The initial design for the required solution focused on

- supplementing IMSMA data with relevant spatial data, including mine action tasking data;
- providing tools for the use of offline imagery as a data source;
- conforming system maintenance to the existing operational workflows; and
- enabling operations coordinators to conduct mine action planning and task reviews with stakeholders, without IM staff support in the majority of activities.

Infrastructure unreliability, specifically electricity availability and the quality of internet connectivity, had a major influence on the technological design criteria of the solution.[3] The RMAC-S IM department made the decision to develop a desktop-based, standalone implementation of the first version of the tool. The remaining primary functional and non-functional requirements for the tool centred on

- low cost and low technology adoption;
- powerful functionality but ease of use, i.e., with a low learning curve; and
- low maintenance requirements still allowing for easy, periodic updates.

In October 2018, the RMAC-S "Field Map" application was rolled

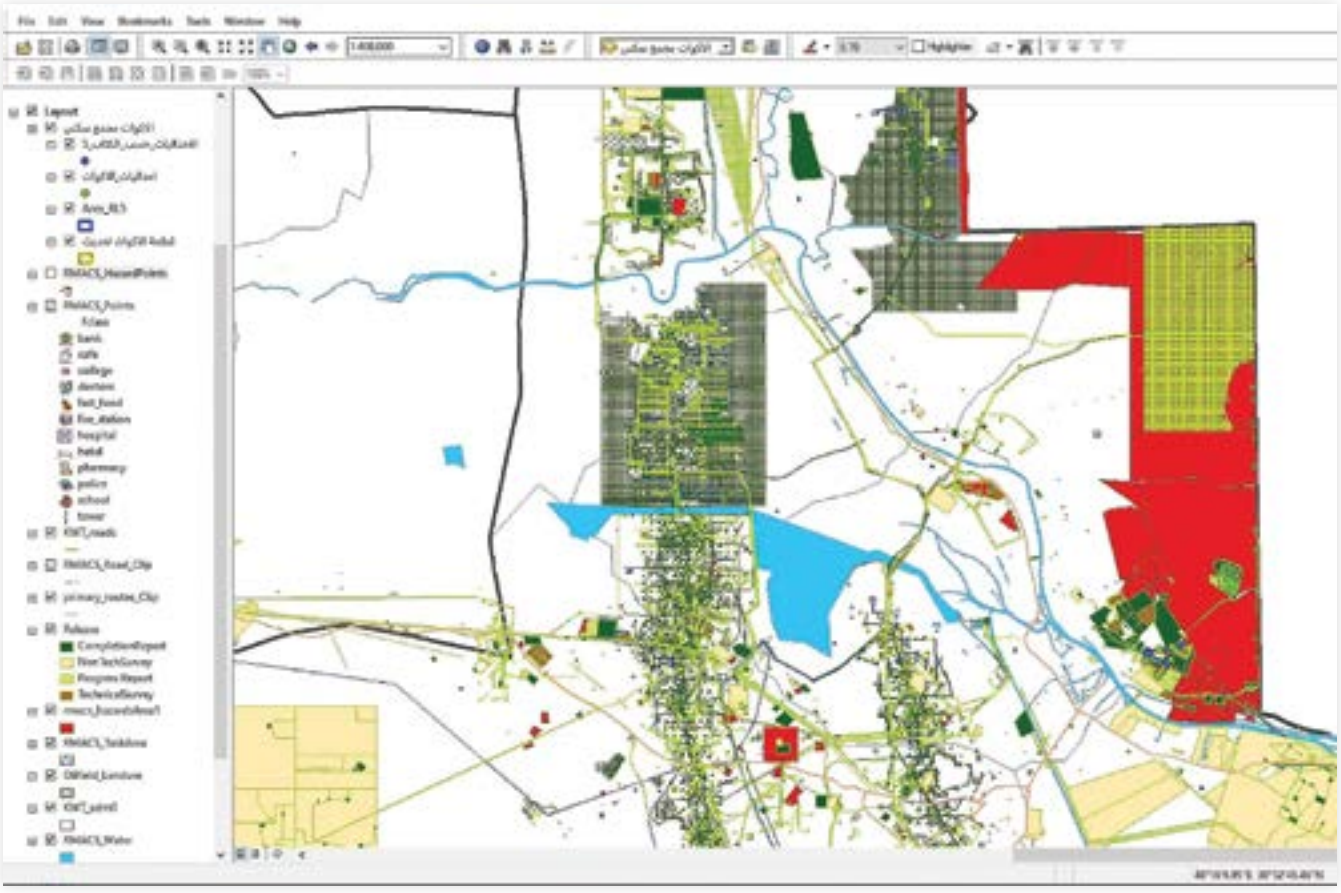

Figure 2. RMAC-S Field Map user interface.

out for use by the RMAC-S operations coordinators with a planned expansion to the management staff following a six-month trial period. The effectiveness of the application, its ease of use, and achievement of the remaining functional and non-functional requirements led to an accelerated adoption by the RMAC-S operations manager that exceeded all expectations, culminating in the mandated use of the Field Map application announcement in January 2019.

Authored in the Esri ArcMap application and using the ArcGIS Publisher extension ArcMap, the RMAC-S Field Map application is a digital spatial data package that enables users to interact with, query, measure, markup, and print high-quality maps while maintaining data integrity in the Esri ArcReader software. The ArcReader application provides users with the ability to view and print maps on the Microsoft Windows platform and only requires the Microsoft.Net platform to be installed before it is deployed. The software is included with ArcGIS Desktop and can also be downloaded for free from the Esri website. The decision to utilize a commercial off-the-shelf (COTS) solution, as opposed to the development of a custom application, was anchored in the range of functionality already present in the application. Moreover, in combination with the desktop GIS software, it allows GIS-capable staff to quickly roll out an easy-to-use MIS tool with a low learning curve.

The RMAC-S Field Map application currently offers the following high-resolution thematic spatial datasets for analysis within the application:

- Administrative boundaries
- Hydrological
- IMSMA data subsets in both polygon and point formats
- Infrastructure
- Oil and gas operations
- Points of interest
- Remote sensing
- Topographic

An additional advantage of the Field Map application is that it offers an intuitive user interface consistent with the look and feel of many GIS applications, which allow for the transfer of GIS application skills to the new application. Inversely, the application also instils the required skills in non-GIS staff for basic spatial data interaction and operations that can then be transferred to desktop GIS applications.

In a country where HMA data management is extremely important and often limits timely access to the required information, the RMAC-S Field Map enables staff to have a nearly 360-degree view of the primary information needed to make well-informed decisions for the benefit of affected communities. This makes it an invaluable asset to all RMAC-S staff involved in the management of the land release process. The impact of this application in increasing the efficiency of service delivery, along with the improved overall situational awareness of the RMAC-S operations staff, is best reflected with a review of one of the application use cases.

RMAC-S conducts annual planning and review exercises with HMA implementing partners and other actors. RMAC-S conducts typical sessions of this format over a two-to-three-day period, with the IM staff required to be present for the full session to assist with data presentation, analysis, and map production. In the second quarter of 2019, a Ministry of Defense (MoD) official delegation arrived in Basra, Iraq, to conduct the annual planning exercise for a scheduled period of three days. The RMAC-S operations manager and his team completed all the required planning activities with the MoD delegation by the end of the first day. The Field Map application not only delivered cost and time savings, but improved relations between the stakeholders through enhanced communications, as well as fast and easy access to evidence needed for informed decision-making.

Comments from RMAC-S Operations Manager, Haitham Fatah, illustrate the success of this operationalized MIS application:

> *… the application presents us [with] the capability to clarify technical discussions and decide on the recommended technical procedure directly in the presence of the beneficiaries and the HMA actors working in the area … being able to discuss and agree on the technical way forward with a task is also having a positive effect on the quality of the various field reports that we receive from our HMA partners, the error rate is significantly reduced, and as Operations, we see that as a direct result from the use of the Field Map application.*

In looking toward future utilization of the RMAC-S Field Map application, users want a version for mobile devices that supplements the desktop allocation map, leveraging the ArcGIS Enterprise platform's web GIS functionality while providing operations coordinators with field-based tools that minimize paper-based workflows and improve data quality and the speed of business processes. A prototype solution is in the final stages of development and will be field tested by the RMAC-S staff and refined for mainstream use by DMA in the near future.

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Mark Steyn
HMA IM Technical Advisor
iMMAP Iraq

Mark Steyn has worked in the GIS industry for twenty-nine years in various capacities. After completion of his military service in the South African Army, he spent two years as a meteorologist on the South African National Antarctic Expeditions (SANAE) to both Antarctica and Gough Island. In 1992, he graduated with a bachelor's degree from the University of Pretoria and since 2018, he has been based in Basra, Iraq, in the role of HMA IM Technical Advisor for iMMAP Iraq.

Arie Claassens
HMA IM Technical Advisor
iMMAP Iraq

Arie Claassens has worked as an HMA IM Technical Advisor for iMMAP Iraq since 2017 after working as a Senior GIS Specialist at Esri South Africa and obtaining a master's degree with distinction in GIS from the University of Leeds. He served as an intelligence analyst in the South African Army, switching career paths to develop and maintain high-security e-commerce infrastructures before finally turning to a full-time career in GIS in 2015. His first exposure to HMA was as a consultant for the United Nations Mine Action Office in Sudan in 2007.

ON-THE-GROUND INFORMATION MANAGEMENT TOOLS IN NORTHEAST SYRIA

Backgroung photo of Al-Raqqa, Syria courtesy of TetraTech.

By Suleiman Nyamwaya and Joel Ndegwa [iMMAP]

Mine action activities in northeast Syria (NES) started in early 2017. At the time, there was a clear need for coordination, and members of the NES nongovernmental organizations (NGOs) forum's implementing programs—including Water, Sanitation, and Hygiene (WASH)[1] promotion, as well as programs representing Shelter, Cash, Health, and Food—experienced tremendous challenges working in a region heavily contaminated by ordnance with no information available on their locations and types. By the end of 2017, iMMAP filled this gap by providing a coordination support platform for humanitarian mine action (HMA) actors through the use of the Information Management System for Mine Action (IMSMA). To date, a geographic information system (GIS) portal, a Power BI dashboard, and an offline mobile data collection tool (MoDAC) are some of the tools used by iMMAP to support HMA actors working in NES.

MINE ACTION INFORMATION MANAGEMENT IN NORTHEAST SYRIA

Through the HMA project, iMMAP provides information management (IM) support to its partners for the collection, analysis, and reporting on mine action data as well as capacity building. The project aims to increase the effectiveness and availability of an overarching picture of HMA activities in the region through continued coordination and technical support to stakeholders including NGOs and national authorities. Over the past three years, the online database recorded over 100,732 explosive devices that were destroyed in the Ar-Raqqa, Al-Hassakeh, and Deir-Ez-Zor provinces of NES.[2]

Back to report | DEVICES FOUND/DESTROYED

Category	Quantity
Unknown	4,595
smallArms	55,189
Scatterable Munitions	11
Rockets	1,039
Pyrotechnics and Flares	07
Projectiles	16,443
Naval Mines	02
Misc Nonexplosive Devices	94
Misc Explosive Devices	239
Landmines	15,468
IED	5,128
Guided Missiles	38
Grenades	1,918
Clusters and Dispensers	361
Bombs	202
Total	**100,734**

Figure 1. Explosive devices destroyed in Al-Raqqa, Al-Hassakeh, and Deir-Ez-Zor provinces in NES (October 2017–October 2020).
All graphics courtesy of iMMAP.

These devices, which claim the lives of civilians and undermine efforts toward recovery, include anti-personnel and anti-vehicle landmines, land-based and air-dropped unexploded ordnance (UXO), and improvised explosive devices (IEDs). They continue to be reported in significant numbers across the region.

The NES HMA activities continue to see significant challenges due to limited demining capacity, a hostile security environment, and the absence of a national mine action authority (NMAA) to provide oversight and support to humanitarian actors.

Prior to the October 2019 Turkish Operation Peace Spring,[3] there were six active partners in the Mine Action Sub-Cluster (MASC)[4] conducting contamination surveys, risk education (RE), clearance, and survivor assistance. The 2019 Turkish Operation Peace Spring and the onset of COVID-19 pandemic restrictions have reduced the number of international (30) and national (120) NGOs operating in NES in 2020. In NES, iMMAP operations provide

- contaminated and cleared area maps
- RE activities and beneficiary mapping
- records of devices encountered (numbers, description and geographical distribution)
- explosive hazard-related incident records/maps.

INFORMATION MANAGEMENT SYSTEMS USED IN NES

The Mobile Data Collection Tool (MoDAC). MoDAC simplifies data collection in the most demanding settings by ensuring better quality data is gathered quickly and more efficiently than using pen and paper, thereby reducing errors.

MoDAC collects survey data, both online and offline and is compatible with Android, iOS, and many other devices. iMMAP developed the tool to enable mine action partners in Ar-Raqqa to record hazardous areas that require clearance services before the return of civilians to their homes, schools, and agricultural lands. The tool plays an essential role in the identification and effective clearing of several homesteads and schools in NES, where most mobile telephone towers have been destroyed and internet connectivity is limited or non-existent. MoDAC lets users collect data offline to be uploaded at a

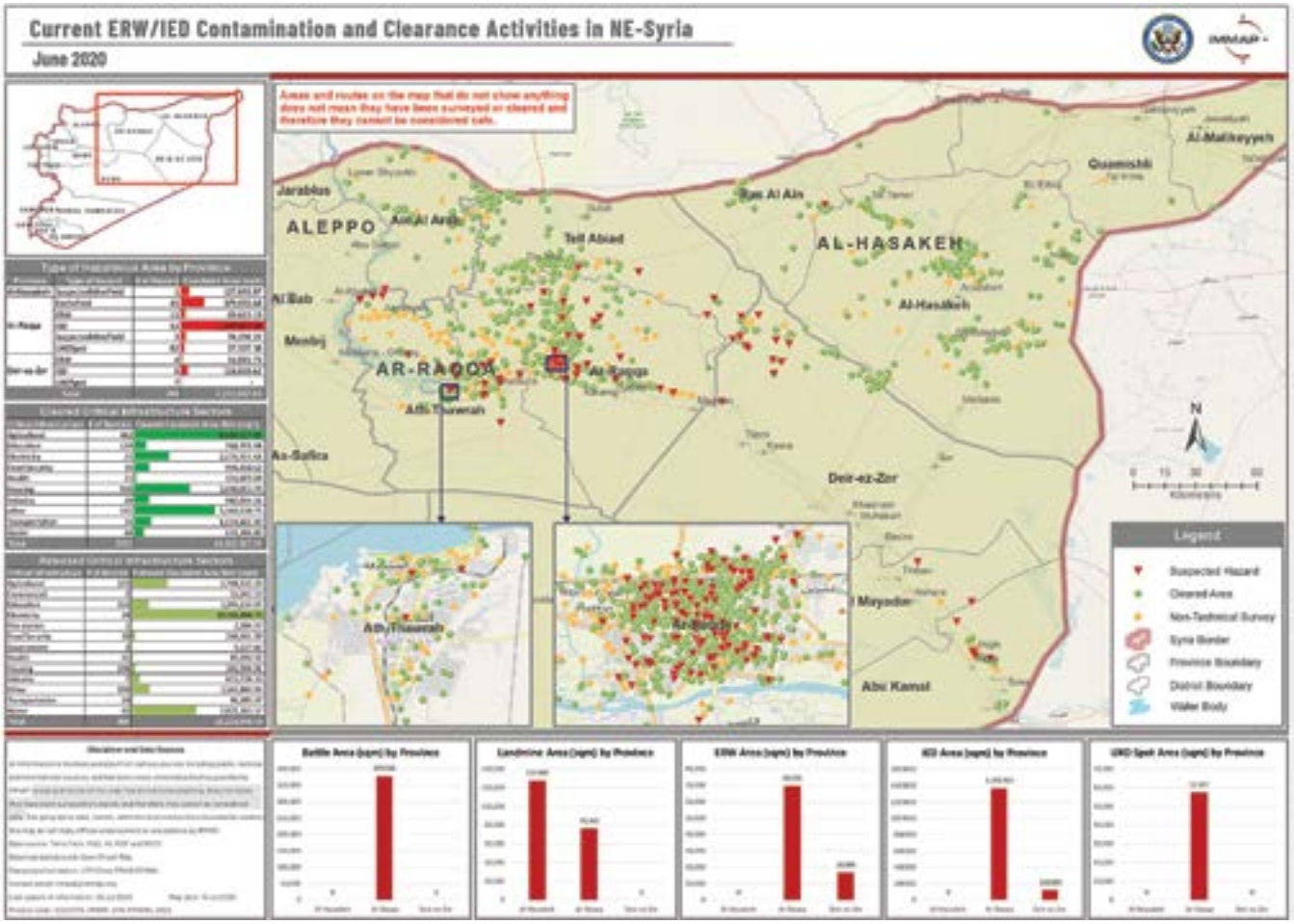

Figure 2. Current UXO and IED contamination and clearance activities in NES.

later time once an internet connection becomes available.

Centralized Database for Humanitarian Mine Action (IMSMA) is used by HMA stakeholders in NES to map areas that have been cleared and those that are still contaminated. The tool is highly customizable to suit the constantly changing IM needs (definition of data types, customization of data collection forms, workflow). After data processing and quality control, the information is used to generate information management products shared with all HMA partners.

Figure 3. Sample message from MoDAC.

GIS PORTAL AS A WEB PLATFORM FOR DATA SHARING

The NES GIS Portal is a full-featured mapping and analytics platform initiated in late 2017 to improve communication and knowledge among MASC members, as well as between the MASC and NES NGO Forum Working Groups. The portal enables the sharing of interactive maps with partners via a web interface. It features

- secure storage and fast access to maps and data,
- optional GIS capabilities for real-time imagery and large data processing,
- increased capabilities with GIS server extensions, and
- enterprise geodatabase (for geodata storage and management).

Figure 4. Example of an attribute pop-up window.

The platform is user-restricted due to the sensitive nature of information it contains and in accordance with the provisions of the memoranda of understanding between iMMAP and MASC members. However, the Map Gallery is open to the public. In summary, the GIS portal is a one-stop shop for a comprehensive understanding of suspected hazardous, cleared, and released areas as well as explosive ordnance RE activities. By clicking on a given point of the map, users open up a window (see Figure 4) containing useful information about that specific area such as province, district, sub-district, city, cleared area, organizations working in the area, number of devices destroyed,

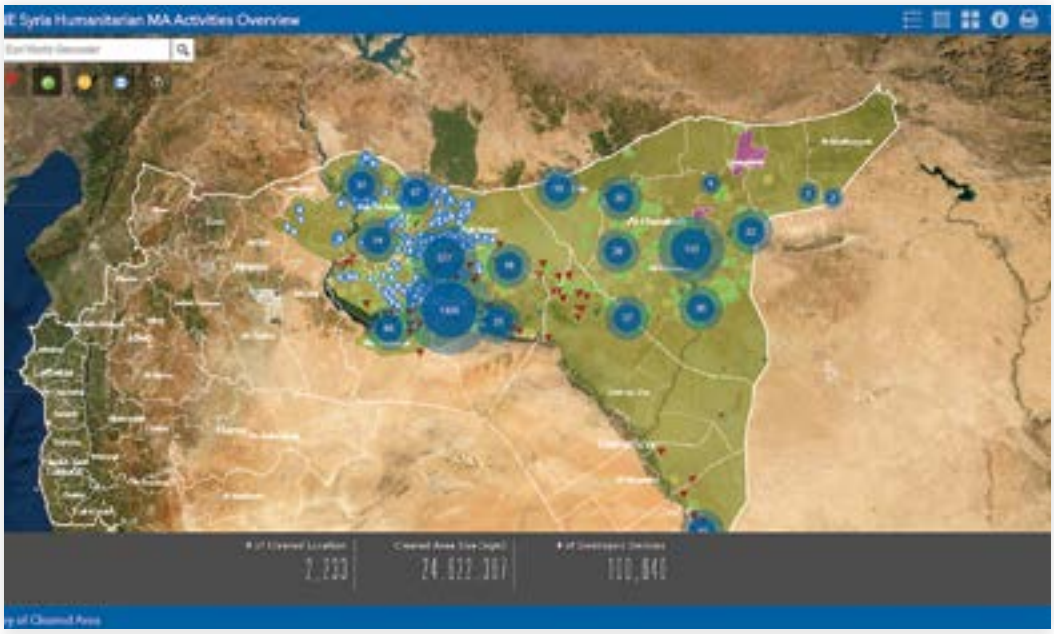

Figure 5. Overview of HMA activities in NES.

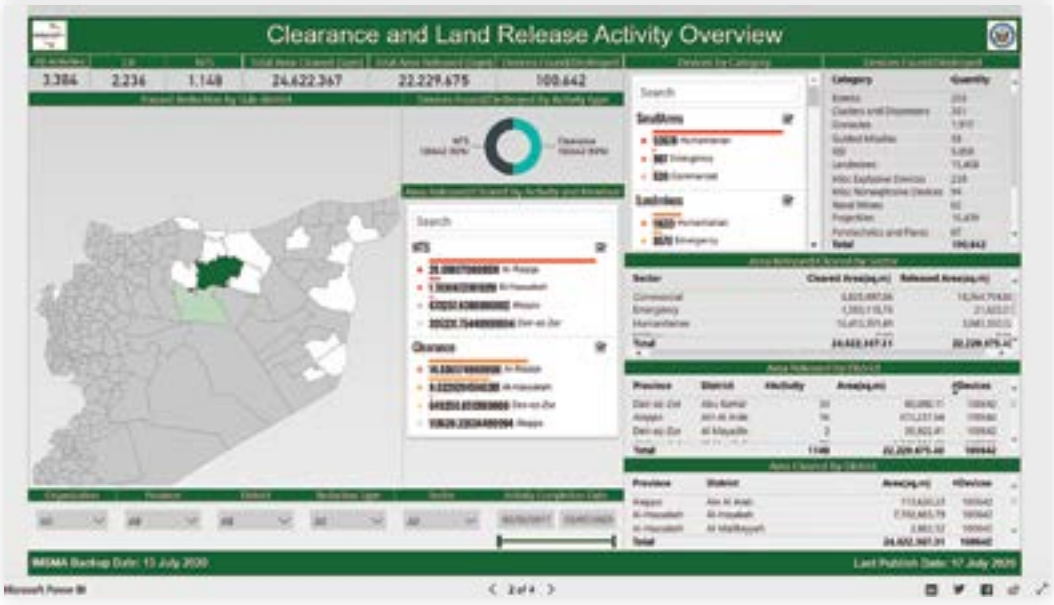

Figure 6. Overview of clearance and land release activities in NES.

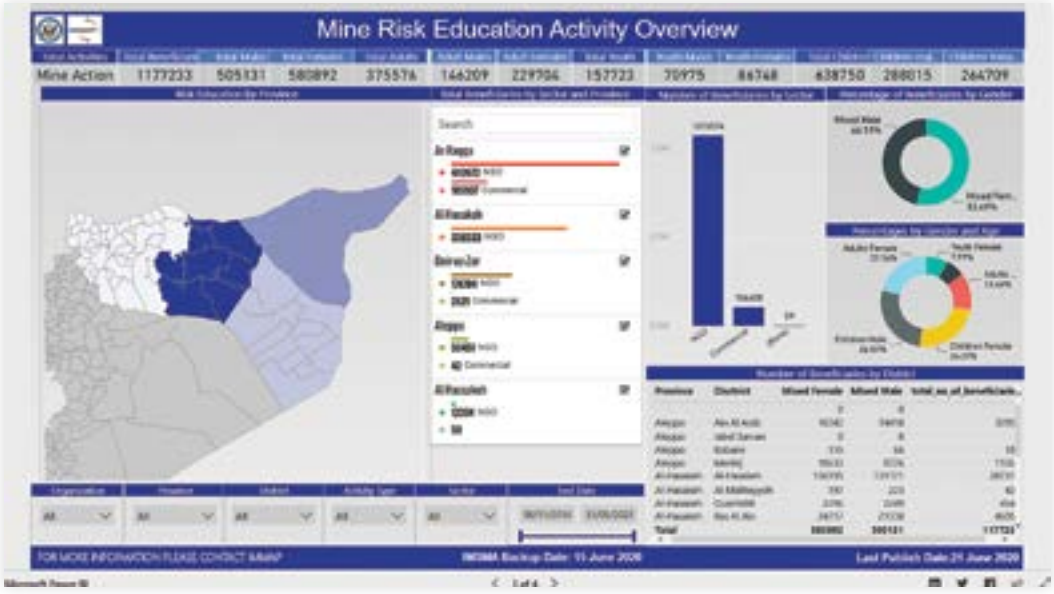

Figure 7. Overview of MRE activities in NES.

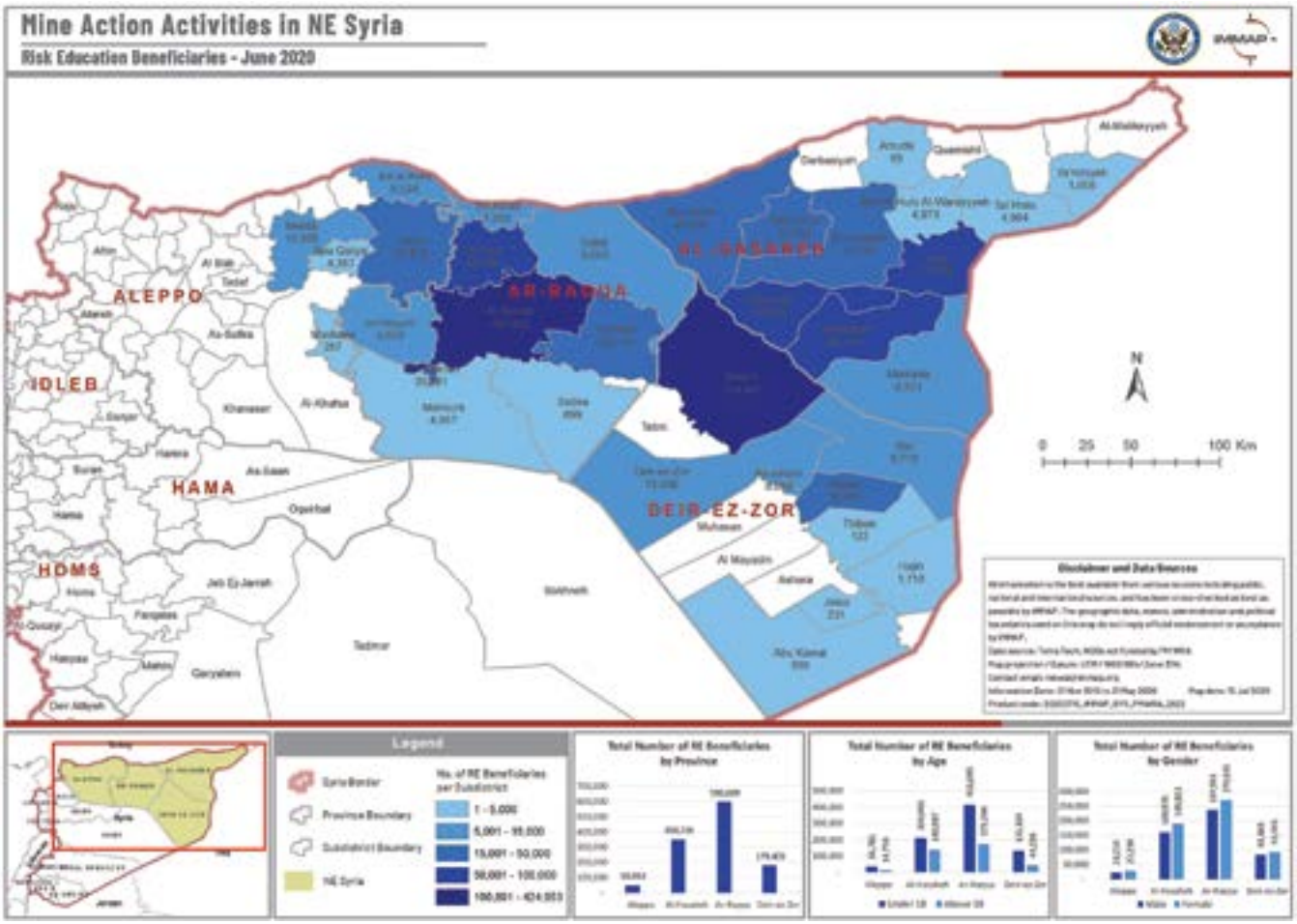

Figure 8. Risk education beneficiaries in NES.

number of risk education beneficiaries, etc. Furthermore, a long list of operational layers is available on the platform that users can display or hide.

POWER BI DASHBOARD

iMMAP uses a Power BI dashboard to generate reports, share data with the organizations working in NES, and integrate seamlessly with existing applications. Power BI is a Microsoft cloud-based tool that simplifies data processing, analysis, and reporting for end-users.

In the context of NES where no NMAA is present, this dashboard enables clearance organizations to view areas of partner activity, thus avoiding duplication of efforts and promoting the efficient use of the limited available resources.

iMMAP is an international not-for-profit organization that provides information management services to humanitarian and development organizations, enabling partners to make informed decisions that ultimately provide high-quality targeted assistance to the world's most vulnerable populations.

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Suleiman Nyamwaya
Humanitarian Mine Action Coordinator, Northeast Syria
iMMAP

Suleiman Nyamwaya is iMMAP's Humanitarian Mine Action Coordinator for northeast Syria. In this role, he supports a coordinated approach to mine action operations by managing needs assessment, gap analysis, and prioritization of response requirements. He holds a Bachelor of Science in civil engineering from the Military College of Engineering in Pakistan, and a Master of Arts in disaster management from the University of Nairobi.

Joel Ndegwa
NES Mine Action Information Management Officer
iMMAP

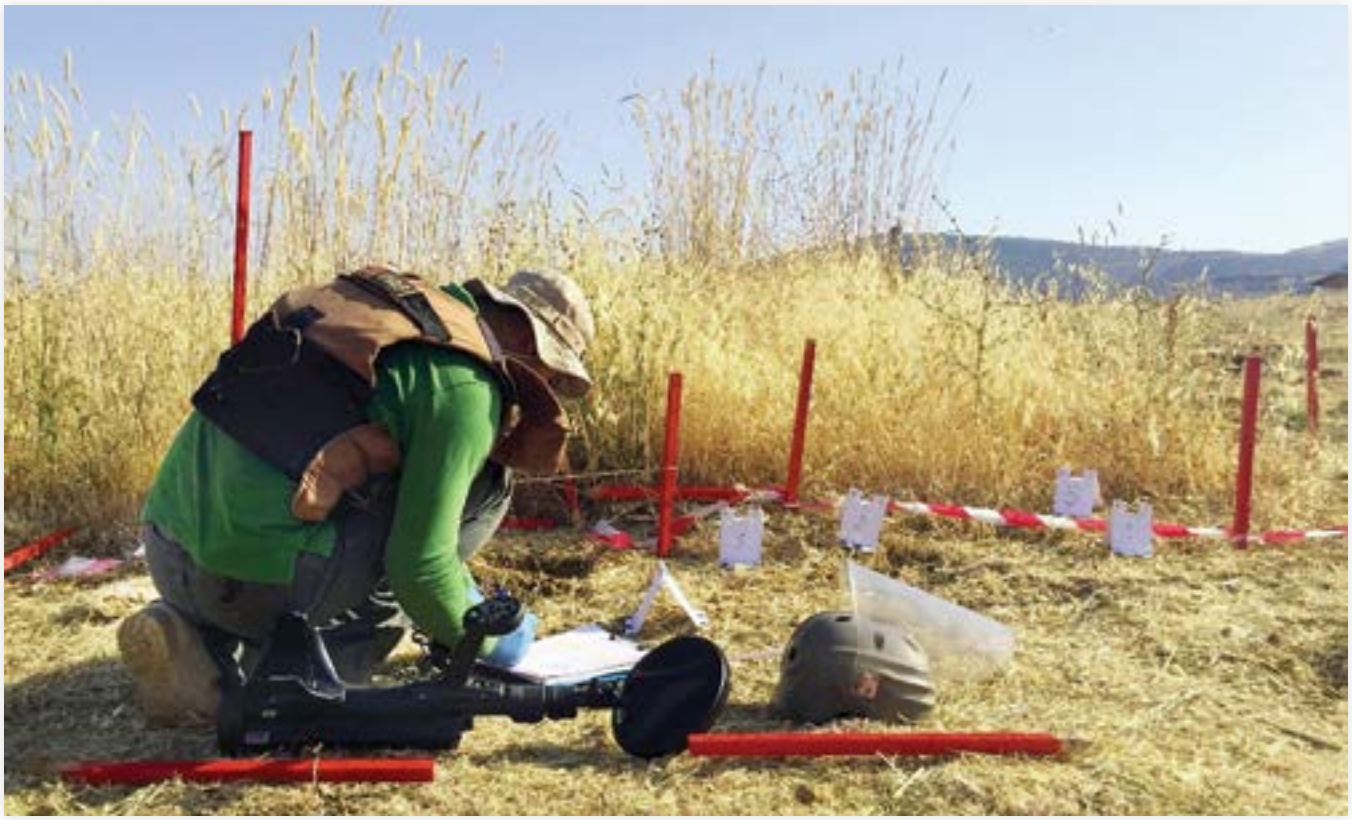
Joel Ndegwa is the Information Manager at iMMAP for the mine action project in northeast Syria. He has ten years' experience with information management systems, both in the private and humanitarian sectors. He has worked in Kenyan telecommunications infrastructure in the field of SMS and USSD and also worked with UNDP Somalia with implementing a contractor information management system for the Somalia program. Ndegwa holds a Bachelor of Science in computer science from Moi University, Kenya.

INTERNATIONAL MINE ACTION STANDARD 10.60

SAFETY & OCCUPATIONAL HEALTH – INVESTIGATION AND REPORTING OF ACCIDENTS AND INCIDENTS

NOTES ON THE REVISED SECOND EDITION

By Roly Evans [Geneva International Centre for Humanitarian Demining]



A Technical Field Manager (TFM) from MAG completes his Evidence Log during an assessed site investigation during the GICHD Accident Investigation Course at the Regional School for Humanitarian Demining Lebanon (RSHDL) in June 2019. The primacy of evidence in the investigative process is one of the key changes in the new IMAS 10.60.
Image courtesy of Ahmad Doghman.

In 2019, the Geneva International Centre for Humanitarian Demining (GICHD) received permission from the International Mine Action Standard (IMAS) Review Board (RB) to update IMAS 10.60, Safety & occupational health – Investigation and reporting of accidents and incidents. The first edition of the document, originally drafted in October 2001 and last amended in June 2013, included a number of areas where significant improvement was possible. In light of this, the IMAS RB established a Technical Working Group (TWG) in October 2019 to enable nominated representatives to feed into the drafting process. The original TWG included representatives from MAG, HALO, NPA, ICRC, HI, Afghanistan DMAC, Tetra Tech, CISR, PM/WRA, and independent members.[1] In time, UNMAS and the military representative on the IMAS RB joined the TWG.

The drafting team had a clear vision of how the original IMAS could be improved. Firstly, and possibly most importantly, the importance of evidence in the investigation process needed to be emphasized. In the old version, evidence was only mentioned three times. In the new version, it is mentioned eighty-one times. As the new introduction clearly states, "an investigation involves the identification, collection, recording and analysis of evidence."[2] Throughout, the document emphasizes the need to identify all relevant types of evidence: physical evidence, witness statements, and documentary evidence. The linking of factual statements to supporting evidence in report writing is also stressed. The document states that "investigators should be able to show not only that conclusions are strictly aligned with evidence but that all relevant evidence has been identified and collected in a competent

A TFM from MAG records crater measurements in the course of an assessed site investigation during the GICHD Accident Investigation Course at the RSHDL in June 2019. Post Blast Investigation including crater analysis was not included in this IMAS due to size limitations but could be a candidate for a supporting technical document, such as a Technical Note for Mine Action (TNMA) in the future.
Image courtesy of Ahmad Doghman.

manner. Evidence *shall* be rigorously recorded and secured so that an investigation can be subsequently analyzed if required." Even simple mechanisms can help with this process, such as the inclusion of a basic evidence log as an annex for the first time and the inclusion of basic forensic awareness procedures.

Another key improvement is the simplification of the reporting timeline following an incident or accident. The previous IMAS split the Initial Report for any incident or accident into two parts. This was confusing, so a change was made to have three clearly separate reports. An Immediate Report will be generated in the minutes after an accident by the team on site, providing key details for the mobilization of support. Then, within twenty-four hours, the organization that experienced an accident or incident will produce an Initial Report, providing strictly factual information about the accident/incident known to date. Within ten days, a Lead Investigator will produce a Detailed Report, ideally mandated by an agreed terms of reference (ToR) from the National Mine Action Authority (NMAA). The aim of this Detailed Report is to provide a comprehensive analysis, rigorously supported by evidence, of what happened and why it happened. Another aspect of the timeline that was changed was the old stipulation that enabled the "demining incident detailed report" (also to be completed in ten days) to "precede a formal investigation." Commencing an external investigation ten days after an accident or incident would, in all likelihood, inherently undermine such an investigation, since it would have little chance of effectively processing evidence from the scene. This is no longer the case in the new edition.

The new version also introduces a new system of different investigation levels. Internal investigations are now termed 1st Party Investigations. Those conducted by the NMAA, including Boards of Inquiry (BOI), are termed 2nd Party Investigations. Investigations completely independent of both the mine action organization in question, and the NMAA, are now termed 3rd Party. Ideally, accidents involving either a fatality or serious injury would be subject to at least a 2nd or 3rd Party Investigation; however, the IMAS recognized this is not always practicable. In circumstances where no NMAA exists, mine action organizations may find that a 1st Party Investigation is the only means of investigation available. In such instances, mine action organizations *shall* fully record the circumstances in their internal ToR mandating the investigation. There is still scope for mine action organizations to conduct a 1st Party Investigation even when an NMAA has initiated a 2nd or 3rd Party Investigation. However, the 2nd or 3rd Party Investigation *should*

have primary control of any accident site as well as all relevant physical and documentary evidence. In short, a 1st Party Investigation *shall* not compromise or interfere in any way with any ongoing or expected 2nd or 3rd Party Investigation.

This IMAS is the first to introduce concepts of causal analysis, albeit in a simple, straightforward manner. Causes are initially classified as *immediate* or *underlying*. Immediate causes tend to be those directly linked to the scene of the accident, such as behavior and worksite conditions. Underlying causal analysis tends to look more at management and organizational factors. The inclusion of underlying causal analysis was one of the key developments in the drafting process. The intent is to encourage organizations to look beyond specific actions on site, and to focus on organizational and managerial factors that could have contributed to the accident or incident. Invariably, the explanations are complex and not only found on site or with the conduct of those immediately involved. Causal analysis is difficult, since inevitably it entails organizations looking closely at themselves and their ways of working. Nevertheless, there was significant support from the TWG for a greater emphasis on causal analysis; this good practice can now hopefully become standardized for all.

The locations of demining and mine accidents and incidents[3] are usually dangerous places. They are also the locations where most of the physical evidence is found. Such locations have to be processed by individuals with suitable levels of training and experience. For the first time, IMAS 10.60 now lists preferred requirements for those conducting site investigations. While not listing specific qualifications, investigation requirements implicitly necessitate experienced and qualified personnel. The IMAS recommends specific accident and incident investigation training for those who might be called upon to fulfill such a task. As yet, there is no set of agreed competencies that such a course would potentially teach. It is possible that the development of such competencies could be recognized as a natural progression for this IMAS in the future.

Another area where the drafting team was particularly keen to see progress was the inclusion of Near Miss reporting. The term *Near Miss* refers to an incident that, while not causing harm, has the potential to cause injury or ill health. This definition was also added to IMAS 04.10, Glossary of Terms. It might be described as a form of incident, although in this IMAS it is effectively treated as a separate category of event. Within other industries such as aviation, Near Miss reporting has been systematized for decades. Within mine action, possibly due to individuals and organizations being fearful of the consequences of admitting Near Misses, such reporting is limited. Some organizations have made significant efforts in this direction in recent years. For example, Tetra Tech has a mobile application that allows staff to electronically report Near Misses quickly and in a standardized format. The system is not abused as a means of undermining the chain of command and has engendered important internal improvements. Near Miss reporting is mandated by a *should* statement in the new IMAS draft; it is not a *shall* requirement. At present, mine action organizations and NMAAs are encouraged to set up credible Near Miss reporting that does not penalize those who are willing to admit fault. In the future, it is hoped that such an approach becomes commonplace.

A TFM from MAG conducts a fingertip search of a small crater looking for evidence in the course of an assessed site investigation during the GICHD Accident Investigation Course at the RSHDL in June 2019.
Image courtesy of Ahmad Doghman.

The TWG also addressed the language used for report writing. Individuals can often intend slightly different meanings to adjectives that describe a level of confidence in an assertion. For example, what is *likely* for one report writer might just be *possible* for another. In an attempt to at least start addressing this subjective approach, the IMAS introduced standard confidence levels. Five levels, with associated percentages, are suggested by means of a *should* statement. These are Certain (>90%), Likely (75%–90%), Possible (40%–60%), Unlikely (10%–25%), and Remote (<10%). The use of such language for indicative probability does not, of course, preclude a subjective approach by any report writer. However, it may be seen as a step toward making the language used by report writers more objective. A future revision of this IMAS might look at the percentage levels so that the complete percentage range is covered.

Other new aspects of the IMAS include a short section on cognitive bias. The intent here is to improve awareness among both investigators and organizations about the universal potential to exhibit some form of cognitive bias. A number of organizations already have good peer review procedures for their accident and incident reporting, including the use of external expertise. It is hoped that, within the confines of applicable data protection legislation, and subject to suitable non-disclosure agreements, such reviews become increasingly standardized.

A student takes his final evidence layout images during an assessed task on the GICHD Accident Investigation Course, Thun, Switzerland, August 2020.
Image courtesy of Edison Pineda.

While full implementation of the IMAS will take time, the GICHD is already mindful of how the document may evolve when it comes to potential amendments. For example, greater clarity is possible when distinguishing between the *should* requirement to report Near Misses and the *shall* requirement to report incidents. Some have requested revised percentages for the confidence levels used. The format of the Detailed Report could be developed further. A number of the TWG members are keen for a central repository for accident reporting to be mandated by an amended IMAS in the future. If work progresses on establishing such a database, it can then be assessed by the IMAS RB. As with all desired amendments, the drafting must balance the need to make valid changes with the need not to overburden field operators with ever-increasing requirements. Hopefully an acceptable balance can be found that ensures this IMAS will serve, rather than hinder, those who implement it. In any case, it is likely that this IMAS will be amended in some way relatively soon. The standard 12–18-month review for all new IMAS, recently introduced by the RB, provides the ideal opportunity for this, as is intended.

The causal analysis section of the document is already a candidate for minor change when the next IMAS amendment is conducted. Lead Investigators at present only *should* be able to conduct causal analysis. In the future, this might change into a *shall* requirement. The factors for both immediate and underlying causes could also be revised. For instance, the addition of a specific equipment factor would add clarity rather than this factor being included within a more general title of "worksite conditions."

This article briefly summarizes some of the main changes to IMAS 10.60. The previous IMAS of 8,504 words became a new one of 13,790. This involved not just new material but a thorough revision of the existing text. Essentially this is almost an entirely new document. It is now one of the longest IMAS in the series. While it represents a significant change for the mine action sector, it is a change supported by the main industry actors represented on the IMAS RB, with no votes against the second edition of the document. This IMAS has already been adopted by key operators such as MAG, who have fully updated their Accident Investigation standard operating procedures accordingly. The overall aim is for the sector to improve collectively, so that we discharge our responsibilities to field staff by learning as much as practicable when an adverse event occurs. The drafting team hope that this IMAS, at least in part, contributes to achieving that aim.

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Roly Evans
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Roly Evans is an Advisor in Land Release and Operational Efficiency in the Risk Management Division at the Geneva International Centre for Humanitarian Demining (GICHD). He has worked in the fields of survey, clearance, EOD, and physical security and stockpile management in Africa, Europe, the Middle East, South Asia, and Southeast Asia.

THE *MINE FREE SARAJEVO* PROJECT

Background photo of Grbavica, a suburb of Sarajevo, in March 1996. *Photo courtesy of Wikipedia.*

By Marija Trlin [Mine Detection Dog Center], Elise Becker [Marshall Legacy Institute], and Nataša Uršič [ITF-Enhancing Human Security]

Mine Free Sarajevo is one of Bosnia and Herzegovina's most important land release projects of the last decade. By the beginning of 2021, the project aims to clear Sarajevo and its surrounding municipalities of Vogošća, East Stari Grad, Stari Grad, and Novi Grad of landmines.

Multiple partners are working together as part of the *Mine Free Sarajevo* project, implementing mine clearance operations, coordinating activities, and promoting the project. ITF Enhancing Human Security (ITF) is the prime grantee managing all clearance, media, and coordination activities. The Mine Detection Dog Center (MDDC) in Bosnia and Herzegovina is serving as the project clearance operator, deploying manual deminers, equipment, and other key personnel to conduct clearance activities. The Marshall Legacy Institute (MLI) is serving as project facilitator, providing monitoring and evaluation and promoting it through media and public relations activities. The work is funded by the United States.

Mine Free Sarajevo was launched on 4 April 2019 at Sarajevo City Hall, where Sarajevo Mayor Abdulah Skaka hosted US Ambassador to Bosnia and Herzegovina Eric Nelson, municipality mayors, project partners, and representatives of the media to announce the beginning of the field operations. The project is a major step toward freeing Bosnia and Herzegovina from its legacy of war and allowing citizens to focus on the future. Additionally, the project is significant in that its clearance activities cross entity borders and are connecting both the Federation of Bosnia and Herzegovina and Republika Srpska.

PROJECT BACKGROUND

Bosnia and Herzegovina is the most mine-contaminated country in Europe. According to data from the Bosnia and Herzegovina Mine Action Center (BHMAC), the total size of suspected hazardous areas (SHAs) in the country is approximately 1,000 square kilometers or 1.97 percent of its total surface area. A general assessment of the impact of mines and unexploded ordnance (UXO)—including cluster munitions—in 129 cities and municipalities in the country identified that around 1,400 communities are affected by these items. The contaminated micro-locations directly affect the safety of more than half a million inhabitants, which is around 13 percent of Bosnia and Herzegovina's total population.[1]

This hidden danger has very real consequences. Since the end of the war, 1,149 people have been injured and 617 people have died as a result of mine accidents as of the end of 2019. Many of them were deminers—since the start of humanitarian demining operations in Bosnia and Herzegovina in 1996 there have been 133 demining accidents with fifty-three deminers killed and eighty injured through the end of 2019.

Deminer removing a mine sign in Trebevic.
All images courtesy of ITF.

A BRIEF HISTORY OF LAND RELEASE IN BOSNIA AND HERZEGOVINA

Mine Free Sarajevo utilizes land release, which is widely recognized as a cost-effective and safe way to release large SHAs by combining technical and non-technical survey and clearance methods. After more than two decades since mine action started in Bosnia and Herzegovina, efforts now focus largely on implementing land release projects. Tarik Šerak, who has been a specialist for the BHMAC since 1997 and is currently the head of the organization's mine action department, is one of the professionals responsible for introducing this method and presenting it to the key players in mine action in Bosnia and Herzegovina.

Tarik and BHMAC began using land release in 2011, after being tasked to find improved and more efficient methods of addressing large mine-contaminated areas in Bosnia and Herzegovina. The pilot project was introduced in 2013, when the organization was involved in implementing new land release methods as defined by the Geneva International Centre for Humanitarian Demining (GICHD).[2] Guided by the recommendations and the framework provided by International Mine Action Standards (IMAS),[3] BHMAC created national land release procedures and standards in cooperation with GICHD specialists.

BHMAC officially adopted three chapters of the national mine action standards that are harmonized with the IMAS, and later added two more chapters of standard operating procedures addressing non-technical survey and monitoring as well as quality control of land-release tasks. The process of creating national standards is ongoing, as they are being revised and updated with new information and experiences. Gradually, the country's government and non-governmental organizations have started working according to the newly adopted methods.

The concept of land release is focused on starting with confirmed hazardous areas (CHAs) and expanding the search until there is no longer evidence of mine contamination.[2] Ideally, land release project areas should have a minimum size of two million square meters because the concept is to connect all the remaining and relatively small pieces of SHAs into one larger area that can then be released by technical and non-technical methods to communities for their safe use. The advantage of this method is that the majority of SHAs are treated by non-technical methods, additional analysis, and data collection in the field, while the technical methods are used only for CHAs. The situation in the field varies from one case to another in Bosnia and Herzegovina. BHMAC usually calculates up to 8 percent of the total size of the land release project to be treated with technical methods, because only 2–3 percent of the territory in land release projects is typically contaminated with mines and UXO. All of these are recommendations provided in the operational plan. However, any additional data obtained are analyzed jointly by BHMAC and MDDC, and are taken into account in order to achieve the goal of land release. All of these are recommendations from the operational plan. Demining teams first start with a targeted investigation of locations and then proceed with a systematic investigation until there is no longer evidence or information of potential danger. IMAS defines targeted investigation as "the investigation during technical survey of certain areas within a SHA/CHA that are more likely to contain mines/ERW." IMAS further defines a systematic investigation as "a systematic process of applying technical survey in a SHA/CHA. It is typically used where there are no areas within the SHA/CHA that are more likely to contain mines/ERW, than others."[4]

Deminer in a search lane.

The final step in each land release project is a jointly signed declaration, in which all parties, including the municipality as the final user, accept that all efforts have been made and the area is safe to be released to the community. The communication between the implementing organization (MDDC), the national authority (BHMAC), and the mine-affected community is especially important in land release. The community, as the final user of the land, needs to be confident that the project was successfully completed, and that the area is safe for use.

LAND RELEASE AND THE *MINE FREE SARAJEVO* PROJECT

The *Mine Free Sarajevo* project consists of several land release tasks, which include SHAs and CHAs in four municipalities in the Sarajevo region. Some municipalities have one, while others have two or even three land release projects to implement in order to make them mine-free. Field operations started in the Municipality of Stari Grad in the Federation of Bosnia and Herzegovina, and the project will be completed when the Municipality of Vogošća, also in the Federation of Bosnia and Herzegovina, is cleared.

Created by BHMAC, each land release project has its own operational plan, which consists of a set of detailed documents issued to

Map courtesy of Google Earth.

MDDC as the field implementing partner. These operational plans are working documents that contain maps and photos, available minefield records, points of entry for the demining teams, interviews with informants, and other important technical details and requirements. MDDC as an organization implementing field activities needs to take into consideration all relevant information, including interviewing reliable informants, and perform technical survey of the designated area and clearance activities. The end result is an entire area released for safe and productive use.

THE MUNICIPALITY OF VOGOŠĆA IN THE FEDERATION OF BOSNIA AND HERZEGOVINA

Of the four municipalities covered by *Mine Free Sarajevo*, Vogošća is among the most mine-affected. The mayor of Vogošća, Edin Smajić, is committed to the goal of making his municipality mine-free. The commitment and involvement of local authorities, as well as the cooperation with all stakeholders involved in the demining process, is extremely important for its success. The mine situation in the Vogošća area can be characterized as complex. During the war, Vogošća found itself on two confrontation lines running through settlements and the industrial complex, lines that also moved closer to the neighboring Municipality of Ilijaš and left behind significant contamination.

After the war, a large number of inhabitants of the municipality lived in constant danger posed by mines. From 1996 to 2019, as many as seventy-five demining projects were completed in the municipality, clearing a total area of 1,663,864 square meters through technical survey and other methods. The *Mine Free Sarajevo* project, along with another US-funded project, *Land Release Project Kremeš*, will allow for an additional release of 5,767,165 square meters of land. These numbers illustrate how demining operations have accelerated via new approaches to releasing SHAs.

I was born and raised in Sarajevo, and to me this project means a lot. Sarajevo is a city with many different cultures and nationalities. When the project is fully completed, and the goal of Sarajevo Free of Mines finally becomes a reality, we will be able to live and move without the fear of being injured by mines, live together and leave the past behind us. I am a mine survivor and I live [a] life with disability due to mines. I would be the happiest person if my country one day becomes free of mines.

~ Selma Gušo, mine survivor, MLI Survivors' Assistant Award recipient for her work empowering fellow women survivors.

When Vogošća becomes a mine-free community, numerous development opportunities will open up, ranging from a boosted economy in the old industrial zone to tourism in the rural areas. Opportunities for housing construction are also opening up, as well as the construction of local roads, which are a precondition for any further development. In communities that have been directly endangered, the safety and possibility of using and enjoying locations that were previously inaccessible is slowly but surely returning.

Mayor Edin Smajić.

Mayor Edin Smajić emphasizes the importance of clearing SHAs, noting that residents, farmers, hikers, cyclists, and others have repeatedly encountered risky areas in their daily activities and have had to organize their lives and pursuits with this threat in mind. All of this was a particular burden for the protection and rescue organizations, given that the danger of mine incidents was present for over two decades. The mayor also emphasized development projects that were stalled due to contamination in Vogošća.

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The Mine Free Sarajevo *project is something that has really facilitated and accelerated all of our efforts so far and we have finally seen the end—or the crown—of all of our demining activities: Vogošća free of mines as part of the entire project. Something that certainly makes everyone proud, especially me as the Mayor, is the final return and putting into operation of the former SHAs. The development of our local community continues. I express my sincere gratitude to the donor in the realization of this project—the United States of America.*

~ Edin Smajić, Mayor of Vogošća

THE MUNICIPALITY OF EAST STARI GRAD IN REPUBLIKA SRPSKA

The mayor of East Stari Grad, Bojo Gašanović, also takes pride in this project, noting that it is a highlight of his years-long mandate in office. East Stari Grad spreads along the longest borderline between the two entities making up Bosnia and Herzegovina: the Federation of Bosnia and Herzegovina and Republika Srpska. Since 1996, there have been twenty different demining tasks completed in this municipality, releasing a total of 500,000 sq m of land. The *Mine Free Sarajevo* project will now release an additional 500,000 square meters of SHA in this municipality, making it completely mine free.

Currently, many roads in East Stari Grad still travel through the SHAs, and the surrounding households are "trapped" between minefields. The municipality also has important development projects that were stopped due to mine contamination, especially industrial and tourist projects. Resorts and other tourist attractions cannot operate without first resolving the hazard of ERW, including on and around Trebević Mountain; however, part of the mountain remains contaminated with mines.

Soon, Trebević Mountain and the rest of East Stari Grad will be cleared, and the mine warning signs removed, no longer diminishing the natural beauty of the mountain or causing fear and anxiety among visitors. Mayor Gašanović is proud to be part of this positive success story and happy to finally be able to say to local residents that they will soon be able to live safely.

When I heard about the Mine Free Sarajevo *project initiative and the implementation of land release projects in four municipalities, I felt true happiness. The city I love and live in will finally be safe. Our mountains will be safe and I love these mountains. I am grateful…to everyone involved in this project.*

~ Mirsad Mirojević, mine survivor, Director of the Sitting Volleyball Club Fantomi in Sarajevo

CONCLUSION

Vogošća and East Stari Grad are just two municipalities that will be mine-free by the end of the *Mine Free Sarajevo* project. The completion of this project will further spur interest in clearance and land release activities focused on making all of Bosnia and Herzegovina mine-free. Therefore, the project has even more far-reaching consequences: the productive use of once-contaminated land and social and economic development. However, above all else, the project will allow its residents to live safely. The impact of humanitarian mine action in the country is truly enormous.

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Mine Detection Dog Center in Bosnia and Herzegovina

Marija Trlin has worked in mine action for twenty years, first at the Donor Relations Department at Bosnia and Herzegovina Mine Action Center, and since 2003 at the Mine Detection Dog Center (MDDC) in Bosnia and Herzegovina. Currently, she is a project manager for mine victims assistance and mine risk education projects, and public and donor relations within MDDC. Trlin holds a university degree from the faculty of Graphic Arts from the University of Zagreb, Croatia. She has published many mine-action related articles in local and international publications.

Elise Becker
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Elise Becker is the Vice President for Operations at the Marshall Legacy Institute, where she manages many of the organization's major programs, including the Mine Detection Dog Partnership Program and Peacemakers and Problem Solvers Program. She has been in the mine action sector for over fourteen years, and previously served as the Frasure-Kruzel-Drew Fellow at the US Department of State. Becker earned her Bachelor of Arts from James Madison University and her Master's in Public Administration from the University of Nebraska at Omaha.

Nataša Uršič
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Nataša Uršič has worked at ITF Enhancing Human Security (ITF) since 2001, first as the geographic-information systems project manager, working with ArcGIS and Erdas Imaging, and since 2004 as ITF's project manager. She works in the fields of mine victim assistance and UXO clearance, managing projects in various parts of Bosnia and Herzegovina, Albania, and the Gaza Strip. She graduated from the Faculty of the Arts at the University of Ljubljana, Slovenia, with a degree in geography and sociology.

WEAPONS MARKING AND REGISTRATION IN BOSNIA AND HERZEGOVINA:

A MODEL FOR A REGIONAL APPROACH TO SALW LIFE-CYCLE MANAGEMENT IN THE WESTERN BALKANS

Background photo: Marking weapons in Bosnia and Herzegovina. *Photo courtesy of The HALO Trust.*

By Mike Newton [The HALO Trust]

The dissolution of the former Socialist Federal Republic of Yugoslavia and the subsequent Balkan Wars of the 1990s left large quantities of weapons and ammunition in poorly managed stockpiles and in the hands of state actors, non-state actors, and civilians. The widespread proliferation of small arms and light weapons (SALW) across the Western Balkans has led to a widely acknowledged problem concerning the diversion of weapons from police and military stockpiles for illicit use in Europe and elsewhere. The diversion of SALW due to poor physical security and stockpile management (PSSM) practices is a driver of armed violence, criminality, and stunted economic growth.

Following a national regulatory assessment with Small Arms Survey ("the Survey") in 2017, The HALO Trust (HALO) has worked with the armed forces of Bosnia and Herzegovina (AFBiH) and the European Force in Bosnia (EUFOR) to professionally mark and register a state military stockpile of approximately 63,000 assorted SALW of over 280 different types. The project comprises a three-way partnership between HALO, the AFBiH, and the UK-based company Pryor Marking Technology. However, the backbone of this unique project is not the marking process per se but the highly comprehensive database and record-keeping system, produced through research and the cataloging of the AFBiH SALW inventory.

With Bosnia and Herzegovina as a case study, this article discusses HALO's needs-based approach in establishing the AFBiH Weapons Marking and Registration project, a first of its kind in the Western Balkans. It analyzes how the project's success can be emulated in other countries across the region to bring about a sustainable solution to the problem of illicit SALW proliferation and diversion through technical expertise, collaboration, and national ownership.

A REGIONAL APPROACH TO SALW MARKING AND REGISTRATION

HALO developed its project in Bosnia and Herzegovina to enhance the implementation of both politically- and legally-binding regional and international frameworks relating to the marking and registration of SALW. At the international level, HALO's work supports the UN Firearms Protocol, the UN Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All Its Aspects (UNPoA), and the European Firearms Directive. In addition, the project directly relates to the UN Sustainable Development Goals (SDGs), specifically SDG 16 and its targets and relevant indicators 16.1, "significantly reduce all forms of violence and related death rates everywhere," and 16.4, "by 2030, significantly reduce illicit/arms flows."[1]

At the national level, HALO's work in Bosnia and Herzegovina falls within the country's normative and political framework on arms control, including the EUFOR-coordinated "Ammunition, Weapons, and Explosives (AWE) Master Plan"[2] and the government's SALW Control Strategy (2016–2020).[3] But how does this fit into the regional plan?

This project directly contributes to the Franco-German Initiative for the Western Balkans and the regional "Roadmap for a sustainable solution to the illegal possession, misuse and trafficking of Small Arms and Light Weapons (SALW) and their ammunition in the Western Balkans by 2024,"[4] coordinated by the South Eastern and Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC). The Franco-German Roadmap stipulates seven goals, the majority of which are to be met by 2024.[5] They relate to substantially reducing the supply, flow, and numbers of illicit SALW in the region while reducing the risk of proliferation and diversion.

The Roadmap is concerned with the illicit use and diversion of firearms from both civilian and police possession and the strengthening of state institutions to address and handle the problem at the legislative and policy levels. A key example of a shortcoming the HALO project can address is the inconsistencies in the marking and registration of weapons seized and confiscated by police. The BiH Marking Law "does not require that weapons are marked at the time of their seizure or confiscation," nor does it state categorically that weapons already in police and military ownership must be marked.[6] As a result, good record keeping and tracking of these weapons is difficult. Strong institutions and faith in them is a key component of making the project a success, but there must be demonstrable, tangible outputs. The AFBiH project is a steppingstone to achieving buy-in from stakeholders and

Team Coordinator (TC) Renata carrying out quality control on a marked M16 as AFBiH staff look on.
All images courtesy of The HALO Trust.

donors, and with the right support, can supplement human security and development efforts across the region.

A SYSTEM TAILORED TO STAKEHOLDER NEEDS

The marking and registration of weapons is "an essential prerequisite for limiting the diversion and illicit proliferation of SALW."[7] In order to develop a system that addresses diversion, a tracing element must be present through a registration and record-keeping function, making a weapon traceable through its entire life cycle. This function requires the development of a database so that the stockpile owner can establish and maintain a reliable inventory of weapons. This marking and registration system enables the tracing of weapons back to the point at which they were diverted from their stockpile.

HALO and the Survey established specific parameters for the AFBiH system during the preparatory phase of the project in 2017 through comparative analysis of the Bosnia and Herzegovina Marking Law and other relevant BiH legislation, with technical guidelines including the now defunct International Small Arms Control Standards (ISACS) and, since then, the more recent Modular Small Arms Control Implementation Compendium (MOSAIC). Equally, HALO and the Survey measured the technical requirements for the record keeping components of the project against the relevant national and international frameworks, including the International Tracing Instrument (ITI).

Identifying the specific stakeholder requirements was essential in developing the bespoke system prior to any marking taking place. The Bosnian Ministry of Defense, Ministry of Foreign Trade and Economic Relations (MoFTER), the AFBiH, Ministry of Security, and EUFOR participated in the preparatory phase. HALO held over thirty meetings and workshops with representatives from each of the stakeholder groups, ensuring collective agreement on each key aspect of the database. Based on this assessment, HALO and Pryor developed a flexible, tailor-made data-capture solution. This ensured that the physical marking process and the database met the needs of the national stakeholders, both in the immediate and longer term.

A SUSTAINABLE SOLUTION THROUGH COLLABORATION

As per the aforementioned framework assessment, HALO, the Survey, and EUFOR determined that the system needed several key characteristics to make it sustainable, effective, and in-line with international standards such as the MOSAIC relating to the particular marking standards and, perhaps more importantly, the ITI with regard to record keeping and data management.

Inventory and weapons catalogue. Pryor and HALO built the database and record-keeping system from the ground up to allow for the input of large amounts of non-marking data in order to assist the AFBiH with broader inventory management. The database enables the AFBiH to include qualitative information on SALW life-cycle aspects such as the serviceability and condition of items. It also allows for the uploading of images of weapons, enabling the armed forces to develop a comprehensive weapons catalogue.

The catalogue upon which the database was built can be used to aid in the establishment of similar projects in other Balkan countries. This would reduce both start-up costs and the time required to establish a workable database in line with stakeholder wishes, ensuring that physical marking and registration can begin quickly. External monitoring and evaluation also allows for lessons learned to be implemented for future projects, increasing efficiency and effectiveness.

Security. Ensuring system and data integrity is paramount to developing any data management system. Two issues arose and were addressed during the creation of the database: (1) the establishment of different authorization levels for users, both across the armed forces and at the ministerial level, and (2) the need to record individual user actions, allowing for tracking patterns of behavior by a specific user.

The integrity of the marking and registering process was engineered to reduce the margin for error as much as possible. Thanks to the comprehensive weapons catalogue that forms the backbone of the database, a supervised operator can select from several preset, drop-down fields with selectable options pertinent to a particular weapon. For example, if the operator selects a specific weapon, the selectable caliber option will be limited to that particular weapon. Every factory serial field must be manually filled in twice, and the system does not allow fields to be copied and pasted, eliminating as much human error as possible from the marking process. Furthermore, every entry into the system and every edit is recorded.[8] Any deleted entries can be recovered thereby

TCs Samir and Renata checking the depth of marks on an M16.

safeguarding against any errors, accidental or intentional.

The database is run through Pryor's bespoke software and is connected directly with the marking machine and its control unit through USB. Once the database issues a number and the operator has filled in all required drop-down fields, the marking happens immediately. The identifying marks applicable to that weapon cannot thereafter be duplicated or changed. Efforts to erase marks will only serve to potentially damage the weapon because the marking trace, when the mark has been stamped into the weapon, can be seen under x-ray and retrieved.

In partnership with EUFOR, HALO conducted complementary training on weapons serviceability and storage management, which will enhance the physical security of the AFBiH stockpile. In addition to marking the weapons themselves and their corresponding registration, the system allows for greater ease of stockpile management through the use of barcodes and data matrices. The chore of stocktaking can be relatively painless when marked and registered weapons are stored in sealed containers labelled with a complex mark that can be quickly and easily scanned, providing an operator with information instantaneously.

Accessibility. The system permits specific users to have different authorization levels, from the unit level up to the relevant ministries. In Bosnia and Herzegovina, the system is configured such that a basic read and print function is available to those within the military concerned with unit-level logistics and PSSM. At a higher level, a write function allows select users to add information for record-keeping purposes without amending the marking data, enabling these users to request a movement of weapons from one location to another. The Chief and Deputy Chiefs of the Joint Staff hold the highest level of access alongside representatives from the Ministry of Defense and the Ministry of Foreign Trade and Economic Relations, who are able to authorize such a move, or in other circumstances, export, write off, or destroy weapons. Every decision is recorded within the system and is fully traceable, ensuring transparency in the handling and movement of SALW, and accountability for those authorizing such actions.

Pryor, HALO, EUFOR, and the AFBiH are currently looking at what the final infrastructure of the system will look like and have not yet confirmed exactly which representatives from which ministries will have the highest level of access. However, once the marking and registration component of the project is complete, the information held on separate registries at the marking locations will need to be merged onto a single database operating on a cloud-based system from a centrally managed server. This will allow live viewing and access along with real-time tracking and record keeping. The beneficiary government should choose the structure of the final system once variables such as connectivity, broader information technology infrastructure, and the routine availability of electricity are taken into consideration.

Sustainability. Pryor provided training for HALO personnel and those working as team coordinators who oversee and manage the daily marking and registration. In turn, the AFBiH marking teams who carry out the technical inventory as well as the marking and registration itself are trained using the "train-the-trainer" approach. This is done through previously trained AFBiH personnel who conduct the training for new marking team members with assistance from HALO and EUFOR staff.

Project sustainability is often determined by levels of funding. While marking team coordinators are HALO staff and funded through bilateral grants, members of the AFBiH comprise the marking teams. It should be noted that the system itself is not reliant on funding but does require personnel with a working knowledge to maintain it. So long as there remains a commitment to fund trained personnel, this life-cycle management system is sustainable. To that end, once the marking of the AFBiH stockpile is completed, HALO will continue to engage with stakeholders to help ensure a smooth transition to full-state ownership of the system.

Crucial to the sustainability of such a system is consideration of the gendered effects relating to diverted and illicit firearms. While this subject itself is beyond the scope of this article, any SALW life-cycle management projects should observe gender as a key consideration. MOSAIC 06.10 states that "ensuring that gender is adequately integrated into all stages of a small arms control initiative is essential to assuring its overall quality."[9] Of the four team coordinators

employed by HALO in Bosnia and Herzegovina, two are women and two are men. As men comprise the majority of the AFBiH marking teams, HALO and the Geneva International Centre for Humanitarian Demining (GICHD) will carry out a joint project once COVID-19 restrictions permit that aims to raise awareness of the gender-based dynamics within the AFBiH teams. A gendered, regional approach to SALW programming in the Balkans would benefit not only national stakeholders but would also drive positive and progressive development throughout the region.

Integration and data sharing. As the building blocks of the database software are Microsoft development tools and backend database platforms, not only does this mean the system has been developed using trusted and robust tools, it also offers flexibility and opportunity for an intuitive information exchange should future integration with other national, regional, or international information management and sharing systems be required. However, it is of the utmost importance to recognize the sovereignty of each beneficiary government as well as the political and cultural sensitivities prevalent throughout the Western Balkans. As such, the ITI states that "the choice for record keeping is a national prerogative."[10]

While there might be the temptation for stakeholders to shy away from acknowledging potential shortcomings in their SALW management systems, the prevention of diversion and the upholding of a sustainable marking and registration system requires an understanding of the problem, the means to address it, and the willingness to be transparent. Transparency is as much a political issue as it is a technical one, and the introduction of new processes often need to be accompanied with a positive shift in organizational culture in order to allow that process to succeed. There might be a hesitation to engage in data sharing due to a perceived lack of benefit either in the material sense or because there can be a tendency to view relationships as zero-sum.

The utility of integrated registries across the Western Balkans is not a new idea. In 2016, a feasibility study stated that "failing to take action now on the subject of linking SALW registries will miss a significant opportunity to capitalize on the regional enthusiasm for collaborative working."[11] As the database and the information contained within belongs to the beneficiary government, the approval of the exchange of information would need to be unanimous. The fact remains that increased transparency and an integrated regional approach to data management are essential to its success.

FUTURE CHALLENGES

Currently, HALO in Bosnia and Herzegovina has marked and registered 95 percent of the military stockpile. The project is on track for completion by the end of 2020. However, there needs to be an understanding from stakeholders and implementing partners alike that the challenges of successfully maintaining these systems begins at the point of project completion. For all the effort that has gone into supporting the implementation of a highly workable system, the measure of success will be in its sustainability.

Where possible, HALO looked to similar projects in an effort to learn from their successes and challenges. The sharing of knowledge and practices across the SALW sub-sector of PSSM, for example, is not yet systematically practiced. In the Balkans, this is in part due to underdeveloped stakeholder relationships and a poor understanding of what different partners could achieve and at what cost. National and regional projects could therefore be targeted more effectively.

In pursuing a regional solution, there is a risk of implementers, whether they be non-governmental or inter-governmental entities, pursuing interventions that are too narrowly focused in scope to have any real impact or too shallow so as to merely pay lip-service to the tenets laid out in the Franco-German Roadmap. In the AFBiH project, HALO has identified a cost-effective and tangible solution, which has the potential to scale across the region.

CONCLUSION

A regional approach in the establishment of sustainable and gender-sensitive marking and registration programs is an essential component of an effective life-cycle management program necessary to achieve a successful, long-term solution to the problems associated with diverted and illicit SALW in the Western Balkans. Although each constituent nation will have its own requirements to which such a project can be tailored, the principles that have ensured the success of the AFBiH project in Bosnia and Herzegovina can and should be applied to SALW interventions throughout the region. The sustainability of such projects rests on three factors: the political will to see them implemented to completion, funding, and the provision of continued support by capable implementers. With that in mind, the future holds opportunities as well as challenges. Donors are increasingly looking for tangible results in the Western Balkans and the well-coordinated partnership between the private, military, and humanitarian sectors in Bosnia and Herzegovina provides a model to support and emulate.

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The HALO Trust would like to thank our donors who fund our work in Bosnia and Herzegovina. We are grateful to the German Federal Foreign Office, the United Kingdom and the Norwegian Ministries of Defense, and the United Nations Trust Facility Supporting Cooperation on Arms Regulation (UNSCAR). HALO would also like to thank our partners in the AFBiH, the Bosnian Ministry of Defense, and EUFOR for their support and coordinated efforts.

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IMPROVING SECURITY IN THE DRC THROUGH WEAPONS AND AMMUNITION MANAGEMENT

Background image courtesy of Katrin Stauffer.

By Beamie-Moses Seiwoh, Aurelie Fabry, Grégoire de Nantes, and Edison Pineda [UNMAS DRC]

Weapons secured by the Congolese National Police in safes provided by UNMAS at a sub-commissariat in Karisimbi, Goma.
All images courtesy of Katrin Stauffer, external M&E Specialist provided to UNMAS DRC by the Swiss Armed Forces, 2019.

Since its independence in 1960, the Democratic Republic of the Congo (DRC) has undergone significant political turmoil. The resurgence of armed conflict since 1996 has displaced thousands across the country and resulted in proliferation and misuse of small arms and light weapons (SA/LW), which remains a serious concern. The diversion of SA/LW and ammunition from state-owned stockpiles is linked to poor or insufficient weapons and ammunition management (WAM) capacity, practices, and procedures, and has been identified as a major cause of illicit arms and ammunition proliferation in the DRC.[1] The trafficking, accumulation, and misuse of SA/LW and related ammunition pose a systemic and pervasive threat to peacebuilding and hampers long-term socioeconomic development.[2] Installation of weapon storage solutions as well as the provision of WAM training, as implemented by the United Nations Mine Action Service (UNMAS), is helping to improve the security situation in the DRC. Moreover, these activities support the United Nations Organization Stabilization Mission in the DRC (MONUSCO) mandate to establish a protective environment for civilians in conflict-affected areas. Additionally, it is in alignment with the National Action Plan for Control of SA/LW in the DRC 2018-2022 (NAP 18-22), implemented by the National Commission for the Control of SA/LW and Reduction of Armed Violence (CNC-ALPC).

In 2018, the Regional Centre on Small Arms in the Great Lakes Region aimed to establish the nexus between fragility[3] situations and the illicit proliferation of SA/LW in the DRC, and examine how this correlation has impacted on livelihoods and human development. This assessment attributed the proliferation of SA/LW to the protracted armed conflict and violence that led to the formation of militia groups, weak border controls, and the porosity of national and territorial borders. A study carried out in Eastern DRC in 2010 (where approximately 300,000 illicit firearms were in circulation at the time) by the Groupe de Recherche et d'Information sur la Paix et la sécurité (GRIP),[4] concluded that SA/LW are key drivers and enablers of conflict. In a 2018 study, Small Arms Survey (SAS) estimated that 945,784 unregistered firearms were in circulation throughout DRC in 2017.[5] These wide-reaching problems contribute to an insecure environment (including food insecurity in the most rural areas) with an elevated rate of armed violence; displacement of populations as a result of internal conflicts, namely territorial conflicts (among pastoralist communities); and armed conflict in neighboring countries, creating significant challenges for the host[6] communities' populations and authorities.

In an effort to combat the threat of SA/LW proliferation, the DRC has committed to regional and international instruments such as the Kinshasa Convention,[7] the Nairobi Protocol,[8] the UN Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in Small Arms and Light Weapons in All its Aspects (PoA),[9] and the Arms Trade Treaty (ATT).[10] The DRC works with partners, including the MONUSCO and UNMAS, to strengthen its national SA/LW framework through WAM.

Marking and numbering of Congolese National Police weapons at sub-commissariat in Karisimbi, Goma.

In line with international standards, UNMAS in DRC supports the reinforcement and enhancement of national security actors' capacity for effective WAM in support of the government's effort to limit and control the circulation of SA/LW and associated ammunition in close cooperation with the CNC-ALPC.[11] Additionally, UNMAS assists in

- improving the security protocols relating to state-held weapons through the assessment of Congolese National Police (PNC) commissariats and sub-commissariats;
- installation of weapons storage solutions;
- marking of weapons;
- training designed to safeguard and manage the SA/LW and ammunition of the national security and defense forces, namely the Armed Forces of the Democratic Republic of the Congo (FARDC) and the PNC; and
- destroying surrendered weapons, in support of national disarmament, demobilization, and reintegration (DDR) programs.

RECENT INITIATIVES

Between July 2018 and May 2020, UNMAS worked to reduce the proliferation, trafficking, accumulation, and misuse of SA/LW and ammunition in Tanganyika, North Kivu, South Kivu, and Ituri provinces. Going forward, UNMAS is committed to further developing an SA/LW incident database to gather information on how the construction and installation of armories, weapon safes, containerized commissariats (i.e., containers that have been converted into police stations for the PNC with secure weapons storage capability), and the relevant WAM trainings contribute to an overall improvement of the security situation in the DRC.

The changing deployment strategies of the national security forces—based on ongoing conflicts—is a challenge that is likely to persist in the future. With the installation of weapon safes and commissariats, UNMAS actively seeks to address these circumstances and responds with "protection through projection," a flexible and comprehensive MONUSCO approach combined with increased mobility and a proactive posture facilitating both police and military interventions. An external evaluation[12] conducted in 2019 on UNMAS DRC SA/LW activities highlighted that containerized commissariats have a direct impact on the security situation, as they increase physical presence on site and improve the mobility and agility of the PNC. By expanding MONUSCO early warning systems that can detect emerging violent hotspots, UNMAS provides police with the ability to leverage their increased physical presence and mobility to intervene quickly and quell rising tensions before they escalate, providing physical protection to civilians.

Assessing needs for storage solutions. UNMAS conducted weapon storage needs assessments for the PNC and FARDC in the provinces of North Kivu, South Kivu, Ituri, and Haut-Katanga. As a result, 230 locations were furnished with 975 rifle safes, 202 pistol safes, thirteen containers for sub-commissariats, and seven armory containers enabling the safe storage of over 17,000 weapons.

Ensuring national sustainability of WAM storage facilities. UNMAS developed and delivered a training package on safe and effective WAM to 1,164 armorers and ammunition storekeepers, including forty-three women, from national security and defense institutions.

Marking and registration. Following UNMAS training, and under the leadership of the CNC-ALPC, FARDC and PNC teams have marked and registered over 18,000[13] state-held weapons in Ituri and Tanganyika provinces as of November 2020. MONUSCO is coordinating efforts with the Office of Weapons Removal and Abatement in the U.S. State Department's Bureau of Political-Military Affairs (PM/

Non-functional weapons collected and prepared for destruction by Police Nationale Congolaise at the sub-commissariat in Karisimbi, Goma.

WRA) to support the CNC-ALPC. These efforts directly contributed toward the NAP 18-22 objective's deadline of 2022.

LESSONS LEARNED

Knowledge Management. After adopting the Nairobi Declaration Protocol in 2004, DRC conducted surveys in order to design the NAP 18-22 for SA/LW. These surveys were neither renewed nor consistently reviewed. As a result, it was difficult to quantify the impact of the policies and programs implemented over the past decade. Moreover, these surveys were outdated and unable to fully reflect the nature, extent, and challenges created by SA/LW proliferation. Therefore, to support the DRC in further strengthening its WAM framework, the CNC-APLC, the United Nations Institute for Disarmament Research (UNIDIR), and UNMAS organized a national consultative process to conduct a baseline assessment[14] of national WAM institutions and methods in the DRC, which was instituted and completed in 2016.

Strengthened national institutions. The CNC-ALPC's dependency on external donors reduces its operational capacities, and the low political backing of other governmental institutions limits its capacity to leverage the international assistance necessary to achieve their goals. Thus, any attempt to support the DRC in clearly defining baselines and targets for a roadmap on the implementation of the NAP 18-22 should be closely coordinated with CNC-ALPC to better assess their needs and strengthen their ability to design programs and monitoring and evaluation (M&E) mechanisms.

DRC's commitment and ownership. The CNC-ALPC plays a proactive and constructive role in coordinating the M&E working group to implement NAP 18-22 for SA/LW control activities, which aim to prevent, combat, and eradicate illicit proliferation, trafficking, accumulation, and misuse of SA/LW and ammunition.

Increased coordination. While the effects of uncontrolled SA/LW proliferation vary between provinces, there are regionally interconnected dimensions. The initiatives advanced by the NAP 18-22 M&E working group or by the local/international counterparts, while helping to respond to isolated incidents often fall short of addressing the common regional needs. Increased coordination among NAP 18-22 key stakeholders and M&E working groups would ensure that efforts are consistent with the needs and priorities set out by the national authority.

FORWARD LOOKING FOR UNMAS

Collaborating with relevant partners and the broader peacebuilding process. UNMAS emphasizes cooperation, particularly with regard to joint data collection, which facilitates better cross-sectoral monitoring. UNMAS also identifies strategic areas for collaboration, focusing on volatile environments such as Beni Territory. This increases human security where needed most but also facilitates comprehensive data collection and lessons learned with regard to the impact of joint activities by conducting small-scale, high-impact case studies.

Maximizing the cost-benefit ratio to safeguard solutions. In addition to weapon safes and container commissariats, which are flexible and cost-effective solutions, still simpler solutions like weapon racks are to be promoted as they are even more adaptable to the changing deployment plans of the national security forces. UNMAS seeks cost-effective methods to deliver weapon storage containers to allow an increase in the physical presence of security staff, which leads to reduced criminality and violence.

Long-term management strategies for installations. UNMAS relinquishes ownership of storage facilities once they are operational. Nevertheless, case studies[15] and recent SA/LW impact evaluations show that the long-term management of installations—including maintenance, repair, and resupply of spare parts—could be drastically improved by the national security forces responsible for these facilities. The M&E consultant provided by the Swiss Armed Forces to evaluate SA/LW storage facilities recommended that UNMAS provide increased support to ensure facilities remain in good working order. Aside from discussions with national security forces on how to best manage and maintain the installations, UNMAS can make a difference by conducting systematic follow-up inspections after installations are in place. By detecting misuse or inadequate upkeep of physical security measures early, UNMAS can better identify additional required training and is currently reinforcing its partnership with United Nations Police to implement such inspections.

Reconsidering WAM training strategies and providing WAM materials. The frequent turnover of WAM-trained personnel—due

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Weapon registration book maintained by Police Nationale Congolaise personnel at the territorial Police Nationale Congolaise commissariat in Irumu.

to the changing deployment plans of national security forces—is an ongoing challenge. UNMAS intends to implement a more integrated approach including developing self-study materials and WAM templates such as registration and inventory books, and weapon security or identification booklets. Through detailed needs assessments, this will require the PNC and FARDC to better coordinate the training needs and deployment plans of trained personnel to ensure at least two WAM trained personnel are deployed in a commissariat or FARDC facility. To address relevant requests for additional booklets, UNMAS aims to provide laminated and resistant posters for all duty stations. In December 2020, UNMAS will also develop self-learning material to national security forces to fill the gap until those National Security Forces receive proper WAM training or in case of rotation, in areas where weapon storage solutions are in place.

CONCLUSION

With the inclusion of SDGs 1 and 16[16] in the 2030 Agenda, the availability and misuse of SA/LW have a recognized negative impact on sustainable development and reduction of poverty. Activities to fight the illicit trade of SA/LW in the DRC should be strengthened, particularly the establishment of a roadmap based on CNC-ALPC/UNMAS joint assessments[17] of FARC and PNC needs and regarding joint data collection to facilitate better cross-sectoral monitoring. SA/LW activities are key to improve the security environment and contribute to the protection of civilians in conflict-affected areas. This increase in the perception of safety has strengthened the local community's confidence to move about without fear and to conduct their daily activities including fetching water and accessing local markets and other key infrastructure. Although this improved perception of safety is based on the mere noticeable presence of national security and defense forces, the local population also registered an apparent improvement in the professionalism of FARDC and PNC when dealing with weapons and ammunition.

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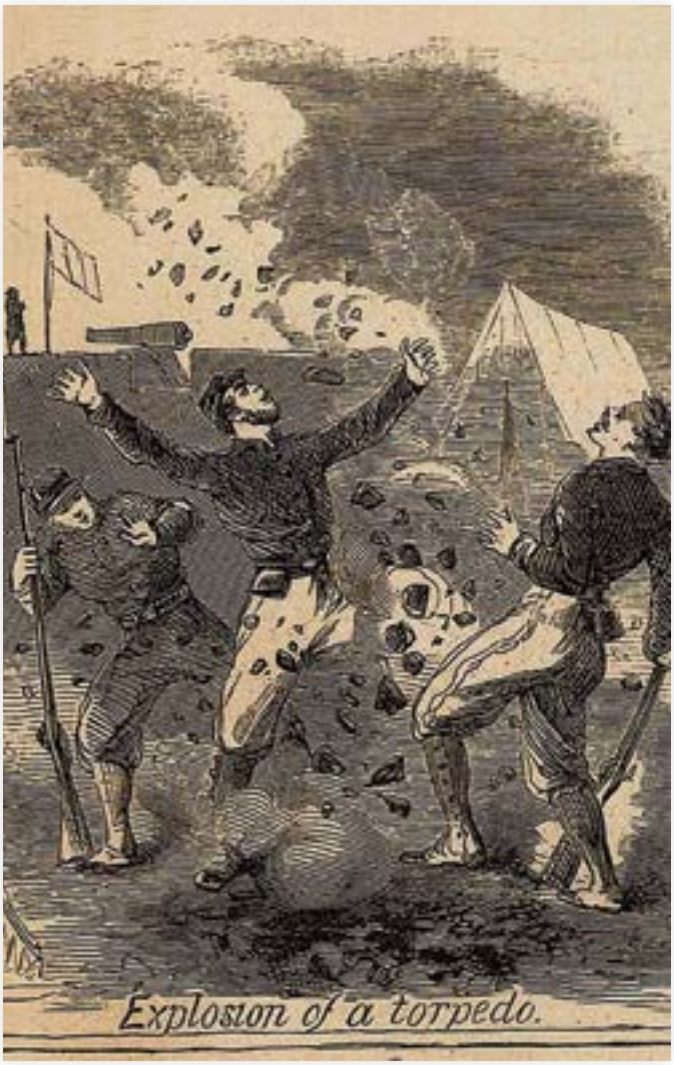
LANDMINES IN AMERICA'S BACKYARD

Background image courtesy of Thomas Nast, Harper's Weekly , *September 20, 1862.*

By Kenneth R. Rutherford, Ph.D. [James Madison University]



Landmine exploding among Union troops at Yorktown, VA.
Sketch courtesy of A.R. Waud, Harper's Weekly, *May 24, 1862.*

Few realize the world's first widespread deployment of landmines took place during the American Civil War (1860–1865). At the start of the Civil War, the disparity in military manpower, materiel, and weaponry between the North and South was significant. The gap widened in the Union's favor as the war progressed, forcing the Confederate war industry to innovate and improvise. That was especially true with landmines. As the conflict progressed, landmine warfare advanced commensurately, and both tactics and technology evolved to include innovative types of design and deployment. During the war's later years, Confederate soldiers used both command-detonated and victim-activated landmines more frequently to defend and to protect static positions, including cities.[1]

At the outset of the Civil War in April 1861, the United States war strategy emphasized the occupation of key Southern harbors, the conquest of the Mississippi River to divide the enemy, and the establishment of a naval blockade around the Confederacy. Within a few years, the Union had established a fairly tight blockade along the coast, and it was no longer possible for the Confederacy to export cotton in large quantities. The South's "white gold" failed to produce the income needed to help prevent the depreciation of its currency and fund the war effort.

The South's economy was based on agriculture, and there were few industries capable of producing the war materials the Confederate government needed to fight the war ahead; thus, it had no choice but to seek more creative ways to fight, including leveraging low-cost weapons with minimal material input. One of the solutions to holding key pieces of Southern territory was the development of landmines from a variety of artillery shells, with increased technological ingenuity adapted to local circumstances. Confederate soldiers eventually configured spur-of-the-moment landmines in a relatively ad-hoc manner. Details were rarely written down, and most of what was recorded was destroyed near the end of the war to avoid the possibility of some leading advocates being charged as war criminals. The simplicity and cost-effectiveness of landmines made their continued use attractive. Today we call these buried or hidden artillery rounds improvised explosive devices or IEDs.[2]

Despite the expanding development and use of landmines, many American military officers, both Confederate and Union, looked upon them with intense disfavor. Landmines were disparaged as the "tools of cowards or offenses against democracy and civilized warfare."[3] Opposition within the Confederacy's high command, especially by Gen. Joseph E. Johnston and Lt. Gen. James Longstreet, abated as the war progressed and Confederates became increasingly desperate to defend their shrinking territory. The arguments against landmine use—at least on the Confederate side—dissipated relatively quickly, and mines came to be viewed as a legitimate, highly-effective, low-cost weapon and methodology of war.

In 1863, the Confederate high command and Congress allocated US$100,000 to establish the Army Torpedo Bureau, which became the world's first institution devoted to landmine warfare. Led by Brig. Gen. Gabriel Rains, a creative and innovative military engineering officer, the bureau offered a new and prophetic philosophy of modern, technological landmine warfare. The organization itself was relatively decentralized. Typically, a single officer (or sometimes two) would oversee

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	Command	Trip Wire	Pressure	Nuisance	Delay
Battery Wagner (SC)			X		
Jackson (MS)			X		X
Fort Blakely (AL)		X	X		
Fort Esperanza (TX)			X		
Fort Fisher (NC)[i]	X				
Fort Gilmer (VA)			X		
Fort Harrison (VA)			X		
Fort Johnson (VA)			X		
Fort McAllister (GA)			X		
Fort McDermott (AL)[ii]			X		
Fort Sumter (SC)			X		
Georgia (southeastern region–late 1864)[iii]			X		X
North Carolina (southeastern region–early 1865)			X		X
Port Hudson (LA)[iv]	X		X		
Spanish Fort (AL)			X	X	
Williamsburg (VA)			X		X
Yellow Tavern (VA)	X	X			X
Yorktown (VA)		X	X	X	X

Table 1. Tactical landmine uses during the American Civil War.

landmine deployment, implementing tactical plans involving the use of home guard units, members of the public, and slave laborers. In such cases, the men of the Torpedo Bureau had wide discretion in how they deployed mines. Once given an order to use landmines, lower-ranking Confederate officers and their troops were able to improvise, usually in a spontaneous act of self-preservation, with adequate time to deploy the mines against often overwhelming Federal forces. The result was the varied deployment of increasingly sophisticated explosive devices and innovative landmine warfare tactics near fortifications and on main invasion routes.

It wasn't until the following year, in 1864, however, that landmines became truly reliable in the field. The Confederacy's efforts were aided by the invention of the Rains fuse, the innovative engineering technology of the Fretwell-Singer torpedoes, the creation of the Torpedo Bureau, and the industrial manufacturing of landmines as opposed to improvising them on the fly.

The Confederates developed two ways to detonate a landmine: victim-activation and command-detonation. Victim-activated (also known as contact-detonated) mines were the easiest to detonate because victims inadvertently triggered them. They were made by coupling a shell and a percussion cap or, later in the war, a purposefully-manufactured detonator. In a postwar memoir about his combat experience, Union surgeon S. W. Gross described the victim-activated landmines as

> *simply large shells arranged with levers connected with a percussion fuze and sunk below the surface of the ground in the supposed path of an assailing party. A pressure of the foot upon the concealed lever was sufficient to explode the shell, resulting in effects similar to the bursting of a like projectile under ordinary circumstances.*[4]

As the first and only head of the Torpedo Bureau, General Rains invented a pressure-sensitive fuse that was much more reliable than previous designs. The Rains fuse could be dialed to various pressures but was eventually stabilized at seven pounds.[5] Victim-activated landmines, including many with the Rains fuse, were used to reinforce defensive devices in such fortifications as Battery Wagner, South Carolina; Fort Blakeley, Alabama; Fort McAllister, Georgia; Spanish Fort, Alabama; the forts at Chaffin's Farm, Virginia; and places such as Jackson, Mississippi, and Williamsburg and Yorktown, Virginia. They were utilized less successfully between Kinston and Goldsboro, North Carolina, in March 1865.

The second type of landmine—which was infrequently used—was a command-detonated device (see Table 1). These were activated by human control through a priming charge with an electrical current or pull wires that would cause a friction-sensitive mixture to ignite. This system required some manner of connection between the person firing the device and the device itself. Although they gave the operator more control, use of command-detonated landmines faced several challenges, including a lack of materials, faulty technology, and inadvertent cutting of the wires by artillery fire or other means. In this friction-primer system, a wire was pulled through a small tube (usually copper) filled with an explosive substance (usually fulminate of mercury) and small grain black powder, which, in turn, created a spark that ignited the powder; the main charge of black powder was then ignited.[6]

Thirty-two lb landmine, Confederate Army, American Civil War, Fort McAllister (GA) State Park Museum, 1864.

PRISONERS OF WAR

As a countermeasure to landmines, Union commanders marched prisoners of war (POWs) ahead of their own troops to identify or detonate landmines deployed by other Confederates or Southern sympathizers (see Table 2). Landmine warfare outraged Union generals such as Philip H. Sheridan and William T. Sherman, and Federal officers frequently took revenge by ordering Confederate soldiers to dig up the landmines. If they refused, they risked execution. In at least six post-fighting situations, Federal forces pressed POWs to clear their own landmines, with occasionally fatal results.[7]

One of the incidents where Confederate POWs were forced to clear their own mines took place in Georgia. After capturing Atlanta on 2 September 1964, Union Major-General William Sherman drove deep into Georgia, destroying the state's resources and the will of its people to fight as he made his way to the important coastal city of Savannah. "I can make the march," Sherman wrote, "and make Georgia howl."[8]

Confederate President Jefferson Davis pressured his generals in Georgia to use landmines as way to obstruct "roads by every practicable means" to delay Sherman's march for as long as possible.[9] As a result, many of Sherman's soldiers "were killed or horribly mangled, or both, by torpedoes [victim-activated landmines] buried near the surface of the roads, railroads and paths, and at all places where men were likely to march."[10]

The manner of the wounds enraged Sherman. "This was not war," he fumed, "but murder." He ordered Confederate prisoners brought up "from the rear of the brigade," told his "soldiers to get a proper distance away," and "directed the prisoners with picks and spades to find the other torpedoes." According to Sherman, he "made them march in close order along the road, so as to explode their own torpedoes, or to discover and dig them up. The Rebel prisoners, he wrote, "begged hard, but I reiterated the order, and could hardly help laughing at their stepping so gingerly along the road, where it was supposed sunken torpedoes might explode at each step, but they found no other torpedoes till near Fort McAllister [near Savannah]."[11]

UNEXPLODED LANDMINES AND CIVILIAN CASUALTIES

Throughout the long war, Confederate soldiers seized stockpiles captured on battlefields or collected unexploded ordnance (UXO) from within their own defensive perimeters in order to use the material as their own ordnance or to convert it into landmines. Sometimes these unexploded shells were "shipped to an arsenal for refitting with copper time fuse adapters and sometimes resorted and/or converted from shell to case shot."[12]

Surprisingly, few civilian casualties were caused by landmines, either during or after the war.[13] A possible reason is that most landmines were laid away from crowded inhabited areas.[14] In fact, most Civil War landmines were used at forts that are some distance from today's urban areas. Many of the forts were purposefully constructed away from the cities they were used to protect—they were designed to provide a first-tier defense so cities could buy time "for the transportation of more defensive forces and/or the 'calling out' of a militia defensive force."[15]

Location	Confederate POWs forced to clear landmines immediately after the fighting ended	Confederate POWs forced to march at head of Federal columns on known landmine infested roads
Jackson (MS)	X	
Fort Blakeley (AL)	X	
Fort McAlister (GA)	X	
Georgia (southeastern region–late 1864)	X	X
Port Hudson (LA)	X	
Spanish Fort (AL)	X	
Yellow Tavern (VA)	X	X
Yorktown (VA)	X	

Table 2. Prisoners of war clearance operations chart.

Some of the unrecovered UXO inflicted civilian casualties. A Union prisoner being held in a Charleston jail, for example, witnessed UXO clearance casualties:

> *I saw two men and a Negro boy who had been killed while unearthing one of our shells. They tried to break off the copper ring with an axe! The thing burst, tearing them to pieces. I hear that several boys have been killed in this way—they pay dearly for their stupidity.*[16]

For a few decades after the war, landmines killed and injured Southerners as they walked through woods or flower-filled fields once defended by Confederate infantry.[17] Thankfully, civilian casualties from this type of ordnance and landmines were low during and after the Civil War. From 1958 through 2006, for example, there were only two known fatalities due to disarming Civil War ordnance.[18]

After the American Civil War ended in 1865, Americans would not deploy landmines on a widespread basis for seventy-six years until World War II. Unfortunately, the deadly legacy of landmines would become a global humanitarian crisis by the end of the 20th century, killing or maiming more than 26,000 people per year, primarily civilians.[19]

INSURGENCY

One of the notable aspects of landmine use during the Civil War was their lack of employment by guerilla or insurgent forces (although

Plaque commemorating Confederate landmines near Fort McAllister, Georgia Historical Commission.

A Rains Fuse, Richmond (VA) National Battlefield Park Headquarters.

some may well have wanted to use them). Most likely this was because the Confederate Army kept the limited number of landmines solely for its own purposes. Improvised landmine production involving the conversion of artillery shells was simply too time consuming and burdensome for guerilla forces, who were usually on the move.

MINE WARFARE: A LASTING LEGACY

By the end of the Civil War in 1865, the Confederates had developed the technical forerunners of many modern landmine and fuze types. Other landmine-related innovations included their deployment to cover retreating forces, the use of nuisance mines to inflict casualties behind enemy lines, and the creation of various types of improvised and manufactured landmines.

Despite the Confederacy's efforts, landmines did not change the outcome of a single major battle, although they did delay pursuing Federals and gave Confederates time to escape at Yorktown and Williamsburg, Virginia, and Jackson, Mississippi. Even in the presence of minefields, Union troops managed to carry out several successful assaults by digging trenches across the fields, including at Battery Wagner outside Charleston, South Carolina.[20]

This article is based on my book, *America's Buried History: Landmines in the Civil War*, which further details how landmine development and the tactics of employing them began and evolved during the Civil War, and how the war's progression mirrored mine development on land and sea. As strange as it sounds today, it was an alliance of a few professionally trained soldiers, ill-equipped home guard units, businessmen, and Masonic members who developed and improved the use of landmines across the Confederacy—a harbinger of future warfare in countries around the world.

Landmines and their antecedents, especially those with origins in the American Civil War, have been widely used through both world wars and in many modern conflicts. After the American Civil War ended in 1865, Americans would not deploy landmines on a widespread basis for seventy-six years until World War II. Their prolific use continues to kill and maim thousands of innocent victims every year. In 2019, according to the *Landmine and Cluster Munition Monitor*, fifty-nine countries—each having more than 100 square kilometers of contaminated land—still reported having landmines: Afghanistan, Angola, Bosnia and Herzegovina, Cambodia, Chad, Croatia, Iraq, Thailand, Turkey, and Yemen.[21] Those used in the 20th and 21st centuries have caused tens of thousands of civilian casualties. The resulting international outrage transformed into a highly-effective global movement to ban landmines and made finding, clearing, and destroying mines a multimillion-dollar business.

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Foreground: Confederate Percussion Mine. Five percussion primers. Conical tin case, 17.25" long. Captured by Federal forces in Richmond, VA, in April 1865 during the Confederate evacuation of its capital city.
Middle: Confederate Percussion Mine. Fretwell-Singer type. Tapered tin case, 13.5" x 0.48". Spring loaded hammer on rod at top. Acquired in operations against Richmond and Petersburg, May 1864–April 1865. Presumably made in the Confederate mine factory in Richmond, VA.
Back Right: Confederate Friction Mine. Tin cylindrical case, 17" x 11" pierced by iron rod through axis terminate by ring bolts at either end. This specimen captured at Richmond during Confederate evacuation of its capital city. April 1865.
Image taken in the basement archival storage at West Point Military Museum.

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STRENGTHENING A SUSTAINABLE NATIONAL CAPACITY FOR GENDER AND DIVERSITY MAINSTREAMING IN MINE ACTION

Backgound photo: A team of female deminers in Cambodia.
Photo courtesy of NPA.

By Laura Biscaglia,* Ros Sophal,** Khun Sochenda,** and Lubna Sabeeh***
*[Geneva International Centre for Humanitarian Demining],
[Cambodian Mine Action and Victim Assistance Authority], and *[Norwegian People's Aid]

Khun Sochenda providing training on gender mainstreaming in survey and clearance to CMAA's quality management team.
Photo courtesy of the Cambodian Mine Action Authority.

Sustainable Development Goal (SDG) 16, "Peace, justice and strong institutions," promotes building effective, accountable institutions to ensure peaceful and inclusive societies for all. This incorporates strengthening relevant national institutions, including through international cooperation and capacity-building initiatives.[1] For the purpose of this article, capacity development is defined as a process to improve performance at the individual, organizational, and broader system levels.[2] When an organization carries out a project, it is also important to consider the implications of each planned action on women, girls, boys, and men of different ethnicities, religions, languages, disabilities, education levels, and other diversity factors. Gender and diversity mainstreaming means considering all relevant factors in every project activity as a way to make sure that the concerns, needs, priorities, and experiences of all project beneficiaries are included in the project's design, implementation, monitoring, and evaluation.

In the context of mine action, strengthening national capacity for gender and diversity mainstreaming leads to more effective and inclusive operations, which consider the different information, requirements, and preferences of all members of explosive ordnance (EO)-affected communities. It is also expected to promote equal opportunities, through ensuring that mine action laws, policies, and practices are inclusive and non-discriminatory.[3]

This article presents achievements in gender and diversity mainstreaming in the mine action sector, both at the individual and organizational level. The Cambodia Mine Action Authority (CMAA) and the Norwegian People's Aid (NPA) Mine Action and Disarmament Programme in Iraq are examples of good practice. Also discussed is the Geneva International Centre for Humanitarian Demining's (GICHD) Gender Focal Point (GFP) Capacity Development Programme's contributions to the gender and diversity mainstreaming work of the previously mentioned organizations.

STRENGTHENING GENDER AND DIVERSITY MAINSTREAMING CAPACITY

National mine action authorities/centers (NMAA/Cs) and operators are increasingly showing a commitment to gender equality and inclusion through the adoption of gender and diversity-related policies, strategies, and action plans, as well as mainstreaming capacity efforts.

Within the Royal Government of Cambodia, one such organization showing a commitment is the CMAA. The CMAA adopted a robust strategic approach to promote gender equality and inclusion through the Gender Mainstreaming in Mine Action Plan 2018-2022 (GMMAP), which includes ambitious targets for the program. The CMAA also established a Gender Team, which implements the GMMAP, and is looking to further develop its own gender and diversity mainstreaming capacity and that of mine action operators in Cambodia, including through capacity development agreements with NPA and the GICHD.

Another example of good practice in the sector is NPA's Mine Action and Disarmament Programme in Iraq. In 2019, NPA Iraq established a Gender and Diversity Coordinator and implemented a number of interventions, including conducting gender analyses in EO-affected communities benefitting from NPA's operations: training staff on the importance of gender mainstreaming in mine action; establishing a network of GFP personnel and a gender-based violence (GBV) incidents reporting system within the organization; and conducting surveys on the conditions of women working in operations teams.

Despite these examples of good practice, several challenges remain. Depending on the context, social and cultural norms can hinder the recruitment of women and members of marginalized groups, such as persons with disabilities and members of minority religious and/or ethnic groups, in both office and operational roles. Specific additional security threats may also apply to these groups, such as a heightened risk of sexual and GBV. At the organizational level, a lack of authentic management commitment to diversity and inclusion, such as not challenging or holding people accountable for discriminatory policies and

Figure 1. Overview of the Gender Focal Point Capacity Development Programme objectives and outcomes.
Figure courtesy of the authors.

practices, can significantly impede gender and diversity mainstreaming efforts.[4] Furthermore, the absence of a clear institutional approach that formalizes measures to promote gender equality and inclusion in strategy, operations, and employment means that gender and diversity mainstreaming is not carried out in a systematic and accountable manner across all levels of an organization. Another challenge is that although a gender- and diversity-focused position or team is often established, it may lack direction and well-defined responsibilities, or is not allocated adequate financial resources to fulfil its mandate due to a low priority or other constraints. At the individual level, one of the factors that most hinders gender and diversity mainstreaming efforts is a lack of skills to both conduct and apply gender and diversity analyses to ensure mine action activities are effective and inclusive.

OVERVIEW OF THE GICHD GENDER FOCAL POINT CAPACITY DEVELOPMENT PROGRAMME

In order to strengthen the gender and diversity mainstreaming capacity of NMAA/Cs, operators, and other partners, in 2019 the GICHD developed and carried out its first global GFP Capacity Development Programme, which is expected to be completed in early 2021. The program seeks to reinforce the positive achievements described previously and address some of the remaining obstacles. The premise of the program is that a single training course is not enough to establish sustainable national and country-program capacity. Instead, the development of an individual trainee's skills must coincide with organizational change to facilitate a systems-based approach that can, with sufficient resources and authority, contribute to individual and organizational transformation.

The GICHD decided to concentrate on the role of GFPs for three main reasons. First, more clarity was needed from NMAA/Cs and operators on the roles and responsibilities of GFPs, as well as on the qualifying criteria to take up this position. Second, the GICHD identified a skills gap in the mine action sector for gender equality and inclusion programming where field-level decisions are taken. Third, GFPs were expected to be generally more available to take part in longer training courses focused on gender equality and inclusion than other staff members.

The role of a GFP is to promote gender equality and inclusion in their organization by advocating, advising, and supporting staff. While the title of the position could suggest that the focus is only on gender, in fact the GICHD believes that it must encompass work on diversity more broadly of which gender is only one among many relevant considerations to take into account. Furthermore, while ultimate accountability for the results of gender and diversity mainstreaming efforts lie with management, a GFP has a crucial role in supporting this work. Because those designated as GFPs within an organization are not necessarily experts in gender equality and inclusion, participation in the Capacity Development Programme can play a pivotal role in equipping them with the relevant knowledge and skills to perform the GFP tasks.

The "Introduction to Gender and Diversity in Mine Action" e-Learning course equips learners with knowledge of where and why gender and diversity matter in mine action. By making the e-Learning a mandatory step in the capacity-development process, it ensures that participants have the same basic understanding of key definitions and concepts. These include how gender norms and diversity considerations can impact on mine action activities, as well as the characteristics of a gender- and diversity-sensitive approach to mine action, especially in community-facing activities. This is followed by a ten-day intensive face-to-face training that equips participants with the skills required to effectively mainstream gender and diversity in the organization's policies, systems, and practices. In this second phase of the Capacity Development Programme, participants develop or reinforce skills ranging from how to mainstream gender and diversity in national mine action strategies or standards, standard operating procedures, and data collection forms, to building the capacity to ensure inclusive employment systems and practices.

Following the face-to-face training, participants complete up to four assignments during the remaining year of the program, in which they apply the knowledge and skills they acquired on the course in their own workplace. These assignments are adapted to the unique work situation and responsibilities of each trainee and the identified gender and diversity mainstreaming priorities of the organization. During this phase of the program, a member of the GICHD supports the trainees, providing technical advice to complete the assignments.

Finally, in the last stage of the program, the GICHD invites participants to take part in an online workshop, during which they have the opportunity to present their organizational gender and diversity mainstreaming work plan, provide updates on what they have achieved, discuss challenges faced, and identify next steps to continue to promote gender equality and inclusion within their organization. Participants in the current program include representatives from twelve organizations, representing both NMAA/Cs and international operators' headquarters and country programs.

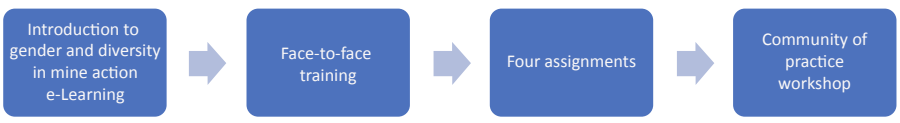

Figure 2. The 18-month Gender Focal Point Capacity Development Programme adopts a blended learning approach comprised of four main activities.
Figure courtesy of the authors.

NPA Iraq conducting a focus group discussion with women from a local community in Rawa City, Iraq.
Photo courtesy of NPA Iraq.

GFPS ROLES AND RESPONSIBILITIES

Anyone working to mainstream gender and diversity considerations, be it a GFP, a full-time manager or advisor, or a working group, must have a clear role and specific responsibilities. Based on consultations with a number of NMAA/Cs and operators, the GICHD developed recommendations on what these responsibilities should include. However, these should always be adapted to the work of the NMAA/C or operator to ensure that they are relevant and realistic in a specific context. The organization's management must endorse the GFP's responsibilities and clearly communicate to staff how the GFP's role will be integrated with the work of other units/teams in the organization.

Prior to participation in the GFP Capacity Development Programme, the CMAA's Gender Team had a network of GFPs deployed in different units/teams across the institution. However, since the Gender Team did not have terms of reference (ToR) endorsed by management, they faced a number of challenges. These included implementing the GMMAP 2018-2022; the availability of dedicated staff trained on gender mainstreaming; and the lack of capacity to conduct gender and diversity analysis.[5] With technical assistance and support from the GICHD as part of the Capacity Development Programme, the Gender Team has now developed a ToR for these GFPs.[6]

There are already positive examples of how the ToR supports the Gender Team to achieve its objectives and reinforces the support provided through the CMAA-GICHD capacity development action plan. For example, the Team now has a more prominent role in decision-making processes with management personnel. The Team has also recently participated in technical reference group meetings, including one on survey and clearance. Moreover, efforts to promote parity of women and men participating in events are paying off. For example, in July 2020, the head of the CMAA Gender Team presented on "Gender Mainstreaming and Diverse needs in practice in Cambodia" at the Intersessional Meeting of the *Anti-Personnel Mine Ban Convention* (APMBC).

In the case of NPA's Mine Action and Disarmament Programme in Iraq, the organization had already created the position of Gender Equality and Diversity Coordinator and allocated resources to support gender and diversity mainstreaming efforts. As the organization was working on defining a job description for the position, participation in the GFP Capacity Development Programme came at an opportune moment. Indeed, NPA Iraq believes that the support provided by the GICHD sustained the organization's ability to adopt a ToR that integrates the full range of tasks that a GFP in mine action should perform. NPA Iraq also developed a work plan, which led to a more structured approach to mainstreaming gender and diversity in its internal procedures, and established a network of GFPs in all the program's field locations. These GFPs have different roles and responsibilities compared to the Gender Equality and Diversity Coordinator. Specifically, they support the Coordinator in the delivery of training courses, reporting allegations of GBV, and maintaining a database in which these complaints are systematically recorded.

GENDER AND DIVERSITY ANALYSIS

Gender and diversity analysis is a tool for understanding how the cultural, social, and economic differences between women and men from diverse groups influence their opportunities and roles in society. In mine action, the main goal of such an analysis is to be able to plan and tailor activities to make them more effective and inclusive. At a minimum, gender and diversity analysis should involve desk-based research to understand more about demographics at the local level. In addition, the analysis should identify decision-making capacity, property rights and ownership, division of labor and livelihood activities, barriers to participation, mobility patterns and access to services, direct and indirect communication channels, and finally the socioeconomic and humanitarian impact of EO on different groups.

In the case of the CMAA, the Gender Team is using its coordination role to encourage Mine Action Planning Units (MAPUs) and operators to conduct gender and diversity analyses to inform operations. The CMAA is now planning to develop a gender and diversity analysis checklist to support the MAPUs and operators to conduct this essential activity and use the findings to tailor activities to the needs of different groups. The development of the gender and diversity analysis checklist is expected to contribute to SDG 10 by putting in place a framework ensuring that mine action operations in Cambodia are inclusive and non-discriminatory.[3] It will also enable the CMAA to demonstrate how it is implementing Actions 29 and 33 of the Oslo Action Plan, through ensuring that community-facing mine action activities are "…sensitive to gender, age, disability and that take the diverse needs and experiences of people in affected communities…" are taken into account.[7]

In the case of NPA Iraq, the organization had already planned to conduct a gender and diversity analysis of Anbar, one of the districts in which the program operates. NPA Iraq's Gender Equality and Diversity Coordinator had previously worked on several field surveys and need assessments related to gender mainstreaming and women's empowerment programs. However, the coordinator had not yet completed a gender and diversity analysis for a mine action project. Therefore, the GFP Capacity Development Programme provided an excellent opportunity to build on her existing skill set and strengthen her capacity to conduct gender and diversity analysis for mine action. Participation in the program helped NPA Iraq identify information requirements

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and create forms for field-level data collection in Anbar District. Both desk-based and field-level research are complete and NPA Iraq is in the process of analyzing the findings to ensure an inclusive approach to activities in Anbar.

LOOKING FORWARD

A sense of ownership is created by focusing efforts on strengthening sustainable gender and diversity mainstreaming capacity at the national and country-program levels. It also contributes to international and national frameworks by ensuring that mine action organizations promote peaceful and inclusive societies for all. This enables mine action programs to not only achieve more with the resources they have at their disposal, but also to better adapt programs, projects, and activities to reflect the real needs and priorities of all beneficiaries in the area of operations.

Ultimately, strengthening the capacity to mainstream gender and diversity in mine action organizations positively influences national capabilities in two ways. First, it promotes gender equality and inclusion in EO-affected communities by challenging traditional gender norms. Second, it contributes to improving the quality of mine action projects and activities, which allow beneficiary communities to receive higher-quality services that are inclusive, effective, and tailored to the needs and priorities of all affected groups, including those in positions of vulnerability, thus spreading the benefits of mine action more equally.

The purpose of the GFP Capacity Development Programme is to enable and strengthen the efforts of NMAA/Cs, operators, and other NGOs in their work by providing them with the knowledge, tools, and skills to achieve their own objectives over time. This is why the program adopted a staged approach spanning eighteen months and which, in addition to training, provides sustained support to the GFPs to achieve the stated goals of their organizations.

The first global GFP Capacity Development Programme will soon be followed by a second program specifically targeted at GFPs from Arabic-speaking countries. CMAA and NPA Iraq are only two out of twelve organizations that are currently participating in the first global GFP Capacity Development Programme. The program has led to the creation of a community of practice trained on gender and diversity mainstreaming, comprised of members who rely on each other's experiences and expertise. Ultimately, the ongoing efforts to strengthen the capacity to mainstream gender and diversity in mine action organizations are expected to improve the effectiveness of mine action policies, programs, and operations by ensuring that the contributions, concerns, and needs of all members of EO-affected communities are acknowledged and addressed in an inclusive manner.

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Ros Sophal has worked in the mine action sector with the Cambodian Mine Action and Victim Assistance Authority (CMAA) for thirteen years. Currently, she is the head of the Database Unit under the Socio-Economic Planning and Database Management Department. In addition, she has been deputy of the gender team for more than five years. In 2019, Sophal participated in the GICHD's GFP Capacity Development Programme. Sophal earned a bachelor's degree in English literature from the Cambodian Human Resources University in 2007 and a bachelor's degree in land management from the Royal University of Phnom Penh in 2006. She finished a master's degree in development management from Norton University in 2014.

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Khun Sochenda is currently deputy director of the Regulation and Monitoring Department at the CMAA. Sochenda began working in mine action in 2010 as the Baseline Survey Unit Assistant under the Clearing for Result Project. In addition to her technical role, she is the deputy team leader in the gender unit of CMAA. In 2019, Sochenda participated in the GICHD's Gender Focal Point Capacity Development Programme.

Lubna Sabeeh
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Lubna Sabeeh works as a Gender and Diversity Coordinator for NPA Mine Action Disarmament Programme in Iraq and is responsible for ensuring and guiding the appropriate applications of gender equality policy, systems, and procedures for the program. For the past decade, Sabeeh has worked for humanitarian organizations, specializing in the field of gender equality and women's protection and empowerment programs. In 2019, Sabeeh participated in the GICHD's GFP Capacity Development Programme. She holds a bachelor's degree in meteorology.

ASSESSING UKRAINE'S VICTIM ASSISTANCE CAPACITIES

Background image: Child EO victim in Svatove, Luhansk region.
Image courtesy of © UNICEF / Filippov / 2019.

By Kateryna Mashchenko, Tetiana Shymanchuk, Oleh Stoiev, and Nick Vovk
[Danish Refugee Committee-Danish Demining Group]

Child EO victim in Svatove, Luhansk region.
Image courtesy of © UNICEF / Filippov / 2019.

Six years into the protracted crisis, explosive ordnance (EO) contamination continues to affect Ukrainian communities. Consequent to the conflict between the government of Ukraine and the so-called *de facto* authorities in the Donetsk and Luhansk regions, EO affects an estimated 7,000 square kilometers of land in government-controlled areas (GCAs).[1] Even without complete data from the non-government-controlled areas (NGCAs), Ukraine ranks among the five most affected places in the world for EO casualties.[2] But for EO victims[3] the path forward remains fraught with difficulties. According to the International Mine Action Standards (IMAS),[4] victim assistance (VA) requires a long-term commitment, a responsibility that state institutions bear. The present article, encapsulating an assessment conducted in 2018 and 2019,[5] highlights the crucial incapacities of the primary VA duty-bearers in Ukraine and puts forth the corresponding lessons learned.

The needs of child EO victims are at the center of our analyses of local VA capacities. Danish Refugee Council-Danish Demining Group's (DRC-DDG) internal database[6] shows 2,060 casualties (resulting from 1,126 incidents) from June 2014 to September 2020; 151 of these were children. Picking up, tampering with, and playing with EO—behaviors characteristic of children—is the third most frequent known cause of EO casualties in Ukraine. Children from poverty-stricken regions are regularly attracted to EO in order to sell them for scrap metal or souvenirs.[7] The impact of hostilities on educational infrastructure remains on the rise: some fifty conflict-related incidents have been reported in 2019. When compared to 2018, this constitutes a nearly 200 percent rise.[8] The presence of military forces within a 1-kilometer radius of educational facilities as well as the infrastructural destruction caused by the ongoing conflict forces some children to cross the EO-ridden contact line every day to attend classes.[9]

Although full clearance is years away, Ukraine is making tangible progress. It has joined important mine action- and VA-related conventions and ensures basic rights to its population through its constitution (and related social protection laws).[10] Ukraine has also adopted the Law of Ukraine "On Mine Action," hereinafter referred to as the mine action law (MAL), on 6 December 2018. Ukrainian Parliament has recently adopted an amendment to MAL (Draft Law No. 2618, adopted on 17 September 2020). However, as of December 2020, it has not yet been signed by the President of Ukraine.[11] To a certain extent, inter-agency communication and coordination on VA exist with social protection units, sanatoriums, rehabilitation centers, and regional-level hospitals currently serving as essential VA intermediaries. Ukraine is also steadily implementing the state-wide inclusion reform (i.e., "The New Ukrainian School"), improving access to education for children with special educational needs. Finally, the government is open to and cooperative with the international mine action community. As a result, DRC-DDG was able to holistically assess the remaining VA gaps.

The assessment took international policies and guidelines as the theoretical background for its research. These included the UN Policy on Victim Assistance in Mine Action[12] and the United Nations Children's Fund (UNICEF) Guidance on Child Focused Victim Assistance.[13] DRC-DDG used these as a framework for the design of the assessment, thereby covering the following topics: laws and policies, data collection, emergency and continuing medical care,

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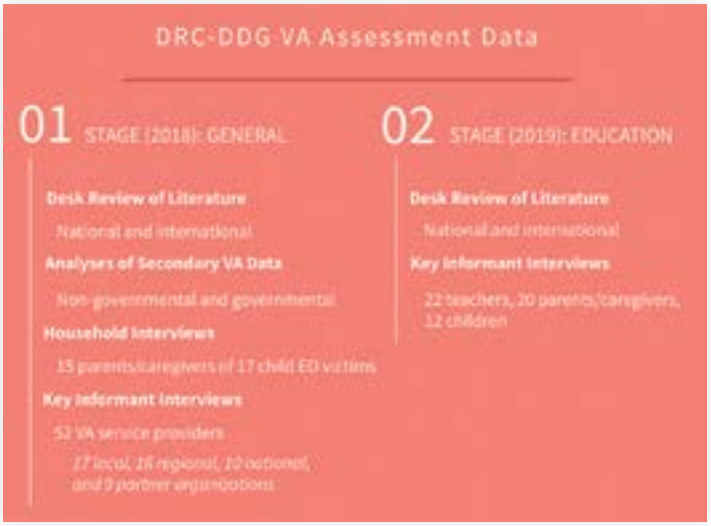

Figure 1. Accumulated Data on VA Assessment in Ukraine.
Figure courtesy of © DRC-DDG.

rehabilitation, psychological and psycho-social support, and socioeconomic inclusion (focusing on education). For this article, we found it pertinent to also share drawbacks and lessons learned about conducting VA assessments. Finally, we have adjusted the terminology of the article to conform with IMAS 13.10 Victim Assistance (First Edition), published earlier in 2020.[14]

METHODOLOGY AND LIMITATIONS

The two-stage assessment employed a mixed-method research approach, including secondary data analyses as well as qualitative and quantitative research tools. In the first stage (2018), the team used a questionnaire (with multiple choice, open-ended, yes/no, and Likert-type questions)[15] for household interviews with parents or caregivers of child EO victims and semi-structured key informant interviews (KIIs) for institutional VA stakeholders. Although difficult to locate EO victims due to stigma, fear, and the lack of a database recording casualty data, snowball sampling[16] was used to reach fifteen parents or caregivers of seventeen child EO victims (from one to seventeen years old) while duty-bearing VA service providers (n = 52) were gathered from three levels: national, regional, and local.[17] For triangulation, secondary data analyses were performed using institutional and internal DRC-DDG sources as well as a desk review of related reports from other humanitarian and development organizations. The second stage (2019) focused on national educational capacities for child EO victims. Here, too, household and KIIs were utilized to contact fifty-four interviewees (twelve children, twenty-two teachers, and twenty caregivers) using a purposive sampling[18] (see Figure 1). For both stages, the two regions of Luhansk and Donetsk were chosen due to the frequency of child EO accidents (see Figure 2). Although the assessment aimed to be comprehensive, certain limitations are noteworthy.

Capacity assessment was constrained by timeframes and wide geographical spread, availability and quality of data, as well as demographics. Each stage of the assessment lasted for three months; however, the conflict-affected areas stretch over 427 kilometers. The nature of a small-sized team, as well as safety and logistical issues, meant that a more in-depth study was beyond reach. The lack of a nationally-owned, EO-casualty database additionally hampered the identification of potential interviewees. Regardless, the DRC-DDG assessment—supported by the German government and United Nations International Children's Fund (UNICEF)—continues to be the only review of national Ukrainian VA capacities.

GAPS IN UKRAINIAN NATIONAL VA CAPACITIES

Laws and Policies. The root cause for many VA incapacities emerges from the underdeveloped legal environment. For any national provision, governments are required to adopt necessary laws, secure budgets, and develop policies, regulations, and procedures. For VA in Ukraine, this is yet to become the case. For years, the Ukrainian response remained *ad hoc*, uncoordinated, and misaligned with best practices from abroad. Not until late 2018, did the government adopt MAL;[19] as of December 2020, its implementation remains troublesome. For VA, two significant challenges exist in the Ukrainian legal framework: unenforced existing provisions and gaps within them.

The current version of MAL provides for a number of services to EO victims but lacks the crucial legal documents, by-laws, and procedures for its implementation. For instance, MAL secures rights to medical, psychological, professional, and social assistance for all EO victims;[20] however, there is no complex system or protocol for the general provision of VA at the state level.[21] Officials are obliged to act exclusively as defined by national regulations.[22] Thus, EO victims either receive assistance at the discretion of local administrations, or simply do not. Many crucial legal documents (e.g., a national mine action strategy) are also missing. Finally, by-laws (i.e., procedures, orders, and directions) required to provide a framework for a national mine action authority and national mine action center are absent. Crucial gaps in the existing legislation are likewise commonplace.

Even where the current MAL is implemented and necessary procedures are adopted, certain gaps weaken the state's VA capabilities. For one, there is no provision on data collection. Unless defined in MAL, such data collection is both legally controversial and halts the coordination of responsible state bodies. Furthermore, MAL does not prescribe the adoption of a national mine action strategy or an action plan; without these, national VA is undermined. What is more, the state allocated a budget line for mine action activities only in 2019 and 2020 (approximately US$185,000). While a separate line on "specialized assistance on prosthetics and rehabilitation" (approximately US$1 million) was included, it is insufficient for the needs of the beneficiaries. Such a lagging legal environment is the common theme for many of the national VA capacity gaps discussed next.

Data Collection. The problematic EO casualty data collection is not limited to Ukraine as mirrored by examples in countries such as Afghanistan,[23] Bosnia and Herzegovina,[24] and Vietnam.[25] Similarly, the establishment of a reliable and complete EO casualty data collection system in Ukraine is in process. Currently, Ukraine has no central agency in charge of the latter, neither is it mentioned in MAL. The state capacity to evaluate the scope of required assistance

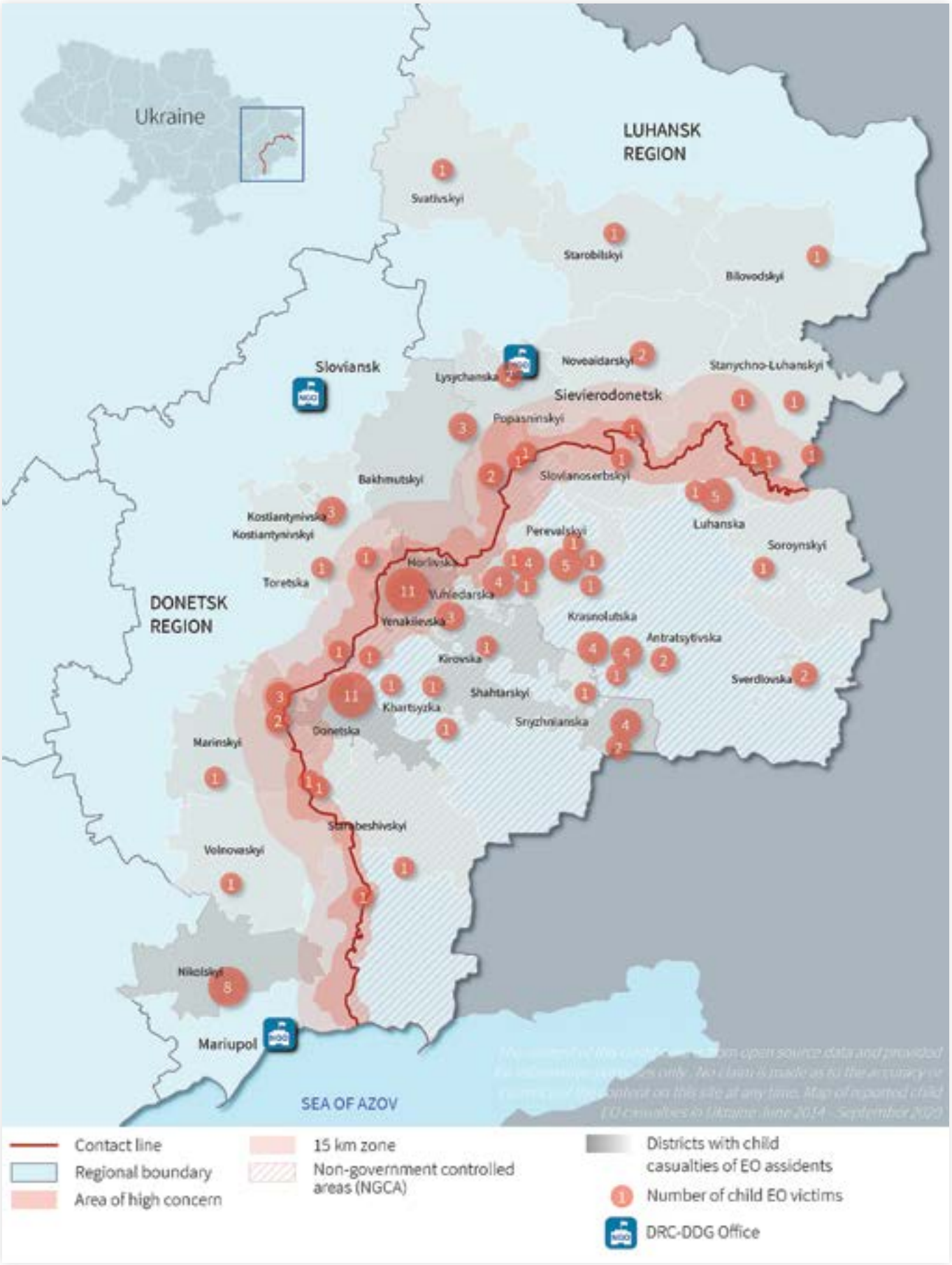

Figure 2. Reported child EO casualties in Ukraine (June 2014 - September 2020).
Figure courtesy of © DRC-DDG.

is further thwarted by the fact that healthcare facilities did not identify EO injuries under the International Classification of Diseases[26] at the onset of the conflict (only in 2018 was a protocol introduced obliging them to do so). As a result, EO victims injured before 2018 face difficulties proving the cause of injury when trying to obtain support. Without a comprehensive victim information system (VIS), it is likewise impossible to accurately quantify the cost of conflict-related disabilities to individuals, the economy, and society at large. The state is hence not only limited in ensuring compensation and assistance for the current EO victims but also in accurately evaluating VA needs for the future.

Emergency and Continuing Medical Care. While emergency care is oftentimes provided at local and district levels, it is the expense of continued medical care and a lack of specialists and equipment that remain problematic and disproportionately affect rural areas. The majority of interviewed victims requiring continuing medical care had to transfer to regional hospitals; lacking external support, many EO victims and their families continue to struggle with such transitions. Moreover, there exists a general shortage of specialists and equipment to treat EO-related traumas in conflict-affected regions. In some of the assessed cases, this led to errors in treatment and the deterioration of victims' conditions. But as noted by the World Health Organization (WHO), for the EO victims and their families it is currently "impossible to assess the quality and capacity of medical facilities in Donetsk and Luhansk regions because of subjective perceptions of quality." The biggest deficiencies have been identified in rural areas due to the long distances that need to be travelled to access adequate medical facilities. This is further exacerbated by the fact that most EO accidents in Ukraine occur in rural areas among a population that is more economically fragile.[27]

Rehabilitation. Rehabilitation in Ukraine has gaps in individual planning, full-cycle prosthetic provision, informational awareness, and state-assigned budgeting. All EO victims with physical disabilities interviewed received an individual rehabilitation plan (IRP), informing them of access to rehabilitation facilities and prosthetic services. Yet, these plans have rarely been made concrete in practice. EO victims also faced difficulties receiving relevant rehabilitation due to omissions or inaccuracies in IRPs. Thus, no interviewed EO victim was availed the full cycle of prostheses: preparation, adjustments, maintenance, and replacement. The procedures for obtaining such assistive devices are not interlinked. As a result, prostheses provided to children are exclusively cosmetic rather than functional. While functional prostheses would provide children with increased mobility, they are more costly and require periodic changes. Their provision and application is also highly specialized and tailored. Fitting would require multiple trips to regional hospitals, making it even more inaccessible for low-income families. Additionally, a reluctance among social protection specialists to fully inform families of rehabilitation services is customary due to a lack of funding. "If the government aims to save money, there will obviously be less incentives to inform families of the available services," stated an interviewed child protection expert. Finally, state funding for the rehabilitation of children is limited. As reported by social protection specialists, the amount provided by the government is normally enough to cover one rehabilitation session annually; however, a child usually needs four.

Psychological and Psycho-Social Support. Ukrainian child EO victims are not supported by an established system of psychological aid or qualified professionals, with distrust for such services prevalent among the population. While MAL asserts rights to psychological and social aid to every EO victim, the majority of them fall short of its full extent. Of the seventeen assessed cases, only eight received psychological support. It was rendered either as generic psychological assistance or therapy at a hospital, emergency psychological counselling post-accident, or as psychological therapy in sanatoriums during rehabilitation, at their schools, or by a non-governmental organization (NGO). Without an established system of psychological aid, rehabilitation and other psycho-social assistances are provided solely from local resources. As expressed during our interviews with national and international NGOs and governmental stakeholders, the latter lack the requisite professional capabilities, as most psychologists operating in eastern Ukraine do not have experience in counselling trauma and are uncertain of their ability to provide such counseling. A further problem is the distrust of psychological counselling, caused by both the underestimation of psychological risks and burdens as well as the costs of such services. It is, therefore, common for families (as well as doctors, teachers, and social workers) to be prejudiced against psychological assistance, underreport their need for it, and reluctantly recognize it as a priority. "He became more reserved and aggressive … No, we are not going to contact a psychologist, we do not need it," mentioned one mother.

Socioeconomic Inclusion. The assessment focused particularly on the educational environment to identify gaps in child EO victims' socioeconomic inclusion. While most of child EO victims continued with education within one-to-three months after the incident (30 percent and 25 percent of interviewees, respectively), those with more severe injuries had to drop out due to ongoing medical care for at least six months to more than a year. Some children faced additional difficulties in their learning due to loss of skills as a result of severe traumas or amputations. Likewise, legislation remains to be fully implemented providing children with disabilities the same opportunity as their peers without disabilities. Despite a state-wide inclusion reform in the educational system, teachers from conflict-affected areas still reported a lack of knowledge, skills, and information on working with children with disabilities and no relevant training on inclusion in schools. Consequently, teaching staff and administrators are sometimes not ready or unwilling to include children with disabilities in their classes. Moreover, there are few (extracurricular) activities for child EO victims due to the absence of afterschool activities at schools, generally, and the lack of conditions and accessible facilities for children with disabilities, specifically.

RECOMMENDATIONS FOR VA CAPACITY BUILDING IN UKRAINE

Laws and Policies. Improving the legal environment for VA will necessitate amending MAL and its corresponding legal documents, assigning an evidence-based budget, and bolstering the legal support

Child EO victim in Svatove, Luhansk region.
Image courtesy of © UNICEF / Filippov / 2019.

to the state. Functional changes to MAL include, *inter alia*, developing a legal status for EO victims, introducing the necessary procedures at all VA stages, and establishing specialized state bodies to lead the national VA response.[28] More data-driven budget allocations would also be crucial. Lastly, it would be beneficial to dedicate adequate resources to legal VA (and mine action) capacities within the government to identify further gaps in legislation and help develop the required legal acts.

Data Collection. There is an acute need to put into place a standardized and centralized collection of EO casualty data given the many issues that arise from its absence. For this, a state policy should be developed and integrated with clear terms and with a distribution of responsibilities among the relevant stakeholders—as is the case in, for example, Cambodia. Such a database should be sex, age, and disability disaggregated, including causes of injuries and incidents from earlier stages of the conflict. It is important to include data on incidents that have taken place in NGCAs to ensure that victims have access to assistance in GCAs. As a result, it would be possible to amalgamate, verify, and report on the incident data via a centralized database and populate a VIS. Statistical information from such a national database should be available upon request to all relevant mine action and VA stakeholders. This will help better identify EO victims, assess the complexity and extent of VA needs, and aid further analyses.

Emergency and Continuing Medical Care. Emergency and continuing medical care for EO victims in Ukraine requires capacity building of medical staff, supervision of EO victims, and allocation of funds for travel expenses. To boost the specialist knowledge of doctors, a coordinated plan for their capacity enhancements ought to be developed and implemented. Training will need to be registered and monitored for refreshment and assessment of continued needs. Since families tend to put less priority into continued medical care, individual supervision of EO victims by medical staff is highly recommended. Medical staff should be aware of cases where ongoing treatment is required, and efforts should be made on both sides (caregivers and medical institutions) to ensure that child EO victims receive all necessary care. Due to frequent long-distance travel required for continuing treatments, the allocation of state funds could bring much-needed financial relief to EO victims and their families.

Rehabilitation. In terms of rehabilitation, we recommend an improved, full-cycled, tailor-made, and needs-based VA system. The current model[5] should be replaced by an improved version in the provision, care, and maintenance of prostheses, aligned with international experience and featuring a broader array of technologies. Furthermore, a full-cycle, coordinated methodology for the registration and follow-on care of EO victims ought to be put into place and linked with records from other types of assistance provided (i.e., psycho-social, financial). The rehabilitation for EO victims also needs to be personalized. Patients should be supported from the initial injury all the way through recovery to exiting the system. A dedicated case manager should act as a focal point for each family so the process is streamlined and lessens the burden on the EO victims. Finally, EO victims need to receive equal prioritization for treatment as those injured by other means: support should be needs- rather than cause-based.

Psychological and Psycho-Social Support. Psychological and psycho-social support requires coordination, governmental strategies, awareness raising and advocacy, as well as a needs-based approach. Lessons learned from other countries[29] would be useful in developing a coordinated support system for EO victims in Ukraine. A dedicated governmental strategy and an allocated budget would ensure access to higher quality psychological treatment. To counteract the reluctance for this support, more awareness raising and advocacy of its importance in the post-traumatic treatment process should be garnered among national duty-bearers (especially schools in eastern Ukraine) and the general public. Lastly, ongoing counselling and psychological

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support for EO victims should be identified as part of the overall rehabilitation and social inclusion plan for each victim and regularly reviewed throughout their path to recovery.

Socioeconomic Inclusion. The four main recommendations for improvements in the social and economic inclusion of EO victims are special approaches to education, capacity building of teachers, disability-centered extracurricular activities, and awareness raising. It is necessary to specify the particular learning objectives for EO victims comparative to their peers without disabilities; to establish individual training or online learning during their treatment; and to ensure their greater involvement in programs befitting their needs, including vocational assistance to enhance their employability. Since the response of teachers to the needs of EO victims fundamentally affects the quality of education and the environment at schools, supporting programs (such as inclusion training) for teachers and children ought to be implemented to build their technical and practical capacities. Regular awareness raising for parents, children, communities, and state representatives to broaden their knowledge on appropriate attitudes towards children with disabilities would also be beneficial. "People on the bus would avert their eyes upon seeing them so my children asked me to buy them balaclavas," explained a parent of child EO victims. For the conflict-affected Donetsk and Luhansk regions, further efforts are likewise required in the development of specialized extracurricular programs as well as sporting and recreational facilities for EO victims and other people with disabilities.

CONCLUSION: FUTURE VA ASSESSMENTS

Taking into account various international policies and guidelines, the assessment of Ukraine's VA looked at (1) gaps in the underpinning legal environment, (2) data collection, (3) emergency and continuing medical care, (4) rehabilitation, (5) psychological and psycho-social support, (6) and socioeconomic inclusion. However, given the limitations of the present assessment, more in-depth studies are recommended for particular segments of VA in the future. For example, it would be pertinent to assess the socioeconomic impact of accidents on child EO victims. The formative years in which child EO victims experience the incidents call for the identification of educational, career, and life prospects of children post-accident. Moreover, a more detailed look at the psychological impact of the armed conflict on the entire social strata would inform VA specialists how to better address psycho-social and psychological consequences. A further inquiry into the rehabilitation, prosthesis, and orthotics systems is likewise deemed key, especially for alignment with IMAS on VA (including physiotherapy, assistive devices, and occupational and speech therapy). Additionally, we recognize that future assessments of medical capacities ought to be conducted by medically-qualified personnel and benchmarked against good practices as illustrated elsewhere.

See endnotes page 66

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Kateryna Mashchenko began her humanitarian career with DRC-DDG at the beginning of the conflict in Ukraine in 2014. She started as a Protection Assistant, and is now the Protection Programme Manager in charge of all DRC-DDG protection projects in Ukraine. In 2007, she received a bachelor's degree in management at the Azov Regional Institute of Management in Berdyansk, Ukraine, while also authoring a number of articles for student scientific conferences between 2005 and 2006.

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Oleh Stoiev has worked for DRC-DDG in Ukraine since 2017, providing legal analyses of the humanitarian context. These analyses included, *inter alia*, matters related to humanitarian mine action; access to justice; right to documentation; conflict-related frameworks; freedom of movement; housing, land, and property (HLP) rights; pension and social protection; voting rights, etc. Oleh holds a master's degree in human rights and public administration from the Mykolas Romeris University of Lithuania and Taras Schevchenko University of Kyiv, Ukraine.

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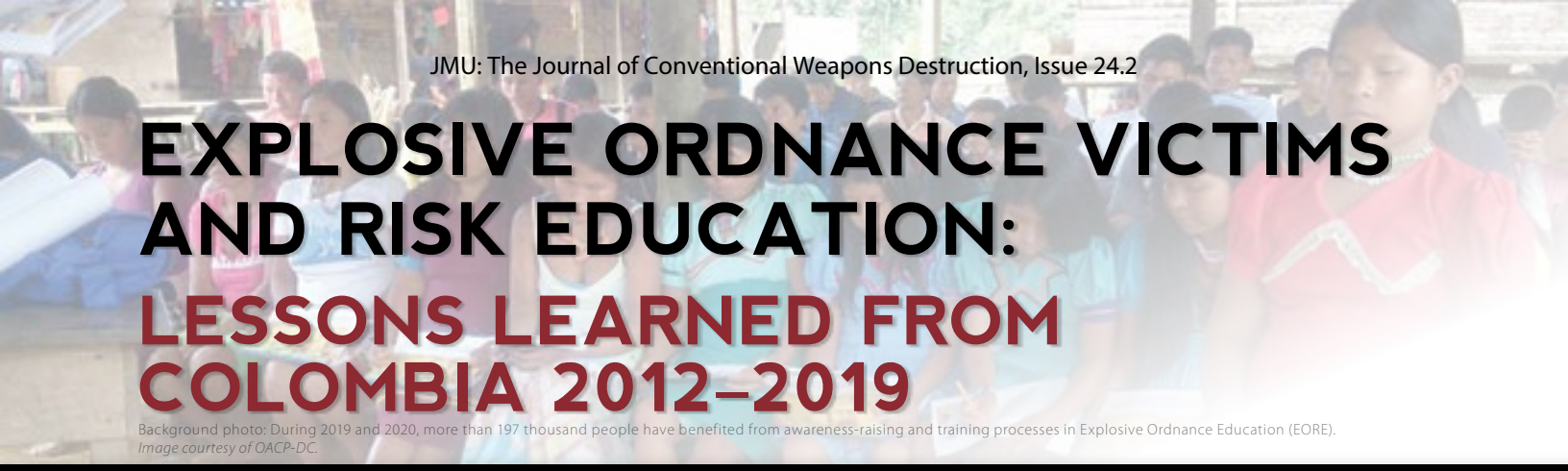
Nick Vovk has worked for DRC-DDG in Ukraine both in grants management in Kyiv and as the DDG Project Manager of integrated mine action projects and explosive ordnance risk education (EORE) activities in Sievierodonetsk since 2019. Prior, Vovk supported research and development projects at the Slovenian Research Agency and was the Assistant Director of an academic think-tank in Slovenia. He also worked for the United Nations Development Programme (UNDP) in Kosovo, researching local public administration capacities. He holds a master of philosophy in development studies from the University of Cambridge (United Kingdom) and a dual bachelor of arts in cultural anthropology and philosophy from the University of Ljubljana, Slovenia.

EXPLOSIVE ORDNANCE VICTIMS AND RISK EDUCATION: LESSONS LEARNED FROM COLOMBIA 2012–2019



Background photo: During 2019 and 2020, more than 197 thousand people have benefited from awareness-raising and training processes in Explosive Ordnance Education (EORE). *Image courtesy of OACP-DC.*

By Salomé Valencia,* Angela De Santis, Ph.D.,* Matt Wilson,* Sebastián Tovar Jaramillo,* Ángela Patricia Cortés Sánchez,** Ana Jaquelin Jaimes Alfonso**
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In Colombia, the use of anti-personnel mines is the result of more than sixty years of armed conflict. The Office of the High Commissioner for Peace[1] - Descontamina Colombia (OACP-DC by its Spanish acronym), the current national mine action authority (NMAA) in Colombia, recorded 11,828 explosive ordnance (EO) victims between 1985 (when victim data recording started) and 2019.[2] Furthermore, Colombia is one of nine countries where new anti-personnel mines are still being emplaced by non-state armed groups,[3] which presents a challenge for the mine action sector.

The aim of explosive ordnance risk education (EORE) is to reduce the risk of accidents by raising awareness and promoting safe behavior among EO-affected communities,[4] which also helps to strengthen communities' relationships with mine action operators and facilitates information gathering during non-technical survey.[5] The Information Management System for Mine Action (IMSMA) database has been used to officially record EORE in Colombia since 2010, although there is evidence of some previous EORE activities.[6] The development of EORE has been progressive and one of the major achievements is the implementation of three different operational models in various regions of the country that respond to specific needs. These models are (*a*) EORE in the educational field, which was the first model to be implemented; (*b*) EORE during emergency situations, including rapid response EORE;[7] and (*c*) EORE within the humanitarian demining and land release framework.[8] Currently, the information management (IM) department of OACP-DC has advanced toward a more systematic and strategic use of the information provided by EORE organizations.

This study, funded by The Office of Weapons Removal and Abatement in the U.S. State Department's Bureau of Political-Military Affairs (PM/WRA), aims to provide a characterization of EO victims and EORE activities between 2012 and 2019 in Colombia, and to identify the lessons learned and challenges faced.

Characteristics	*Category*	*Number*	*Percentage*
Gender	Women	114	5.8%
	Men	1,844	94.2%
Age	Below the age of 18	268	13.7%
	Above the age of 18	1,690	86.3%
Activity	Public Force	964	49.2%
	Proximity	225	11.5%
	Eradication of illicit crops*	173	8.8%
	No information	123	6.3%
	Collecting food, water, or wood	85	4.3%
	Walking on a usual road	85	4.3%
	Playing	70	3.6%
	Agriculture	63	3.2%
	Public Force activities	42	2.1%
	Handling	41	2.1%
	Looking after animals	35	1.8%
	Cleared area	18	0.9%
	Walking on dirt roads (shortcuts)	10	0.5%
	Hunting and fishing	9	0.5%
	Maintenance of infrastructure	7	0.4%
	Demining work	4	0.2%
	Working at home	4	0.2%
Impact	Killed	1,706	87.1%
	Injured	252	12.9%
Total		1,958	

Table 1. Sociodemographic characteristics of explosive ordnance (EO) victims in Colombia, between 2012 and 2019.
Table courtesy of Office of the High Commissioner for Peace-Descontamina Colombia (OACP-DC).

METHODS

The Swiss Foundation for Mine Action (FSD) carried out data analysis from 2012-2019 using the organization's statistics repository and the EORE activities and EO-victims' databases.[9] Only direct beneficiaries were included in this analysis and included the number of people receiving EORE safety messages through interpersonal EORE, mass

Characteristics of EORE beneficiaries			
Beneficiaries	**Total**	**491,955**	
		Number	**Percentage**
	Men	285,239	58%
	Women	206,716	42%
Age	Below the age of 18	191,149	38%
	Above the age of 18	300,806	62%
Ethnicity	Indigenous	51,313	10%
	Afro-descendent	46,648	10%
	Mestizo	395,086	80%
EORE Model	Educational	53,156	10.8%
	Emergency situations	171,674	34.9%

Table 2. Characteristics of EORE beneficiaries in Colombia between 2012 and 2019.
Table courtesy of (OACP-DC).

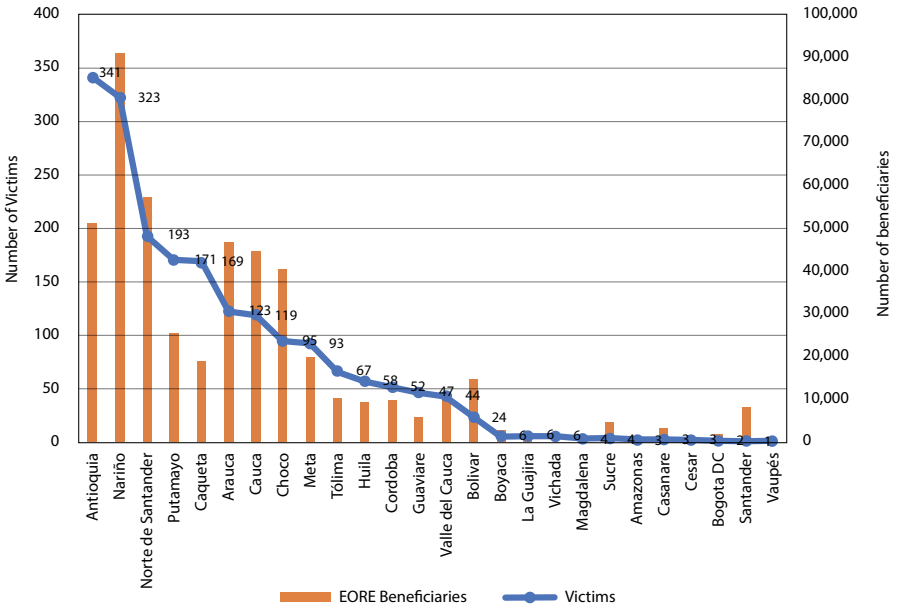

Figure 1. Number of victims and number of beneficiaries by department.
All figures courtesy of the authors.

and digital media EORE, and training of trainers in EORE delivery. The analysis included descriptions of the main characteristics of victims, the density of EO victims, and EORE beneficiaries by departments in the ten most strongly affected municipalities. Additionally, FSD carried out a correlation analysis between EORE activities and the annual number of victims. Challenges encountered and lessons learned were identified by secondary research through a documentary review and analysis in collaboration with the OACP-DC EORE team.

RESULTS: EO VICTIMS AND EORE STATISTICS

From 2012 to 2019, 1,958 victims were recorded, corresponding to 16.5 percent of the total 11,828 victims registered in Colombia since 1985. According to the sociodemographic characteristics of the victims (see Table 1), the majority were male and generally over eighteen years of age, and 87 percent were injured during the course of the accident (13 percent were killed). Accidents most commonly occurred during public force[10] activities (51.4 percent), walking near mined zones (11.5 percent), and during the manual eradication of illicit crops (8.8 percent).

In the period under analysis, the highest number of victims (295) was recorded in 2012, followed by a progressive decrease until 2017 (Figure 2). Six out of the twenty-six EO-contaminated departments in Colombia presented 70 percent of the total number of victims (Antioquia, Nariño, Norte de Santander, Putumayo, Caquetá, Cauca, Arauca). At the municipality level, victims were recorded in 187 out of 1,222 municipalities of Colombia, with the following distribution: two to nine victims in 55 percent of the municipalities, ten to twenty-nine victims in 18 percent, and one victim in 17 percent of the municipalities. The municipality of Tumaco, in the Nariño department, ranked first with 11 percent of the total victims.

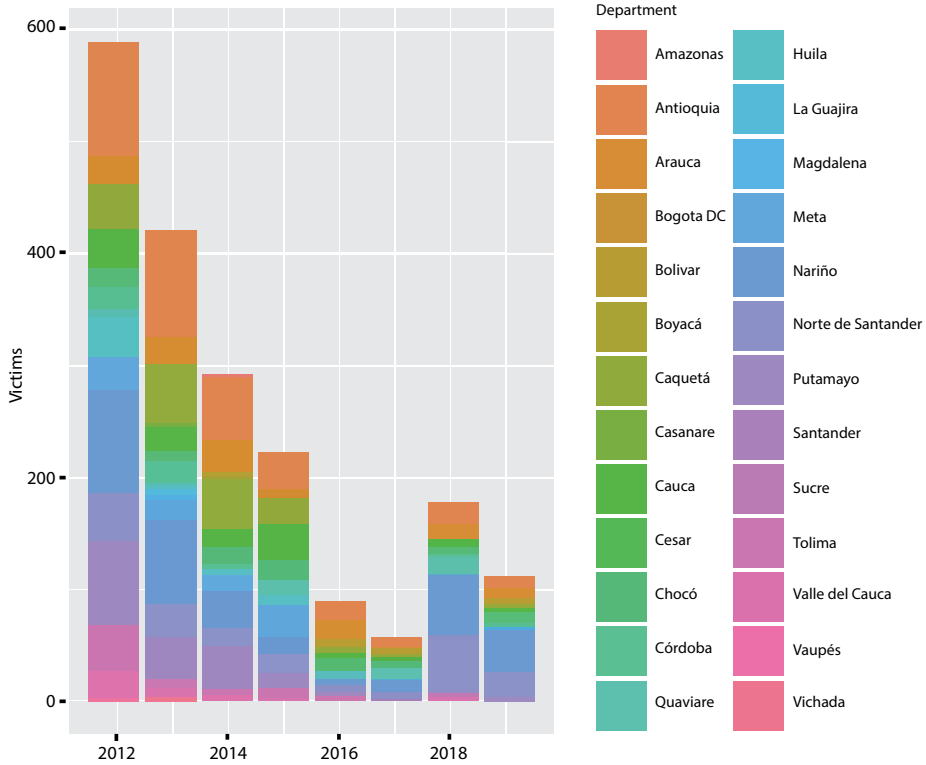

Figure 2. Number of victims per year by department

With regards to EORE activities, the reporting process to OACP-DC by EORE organizations, and the subsequent record in the IMSMA database, has improved and led to more reliable data in recent years compared to the beginning of the study period. According to IMSMA, 15,797 activities were reported by forty different organizations, with a total of 491,955 beneficiaries during the study period (Figure 3). Eighty percent of EORE activities were carried out within the last three years of the period, with 2019 being the year with the highest number of activities (7,496 activities and 191,916 direct beneficiaries): more than double compared with the previous two years. According to the EORE model applied (Table 2), 1,639 activities (53,156 beneficiaries) correspond to EORE in the educational field; 5,436 (171,674 beneficiaries) to EORE in emergency situations; 5,308 (92,106 beneficiaries) to humanitarian demining EORE; and 3,414 (175,019 beneficiaries) to rapid response EORE.

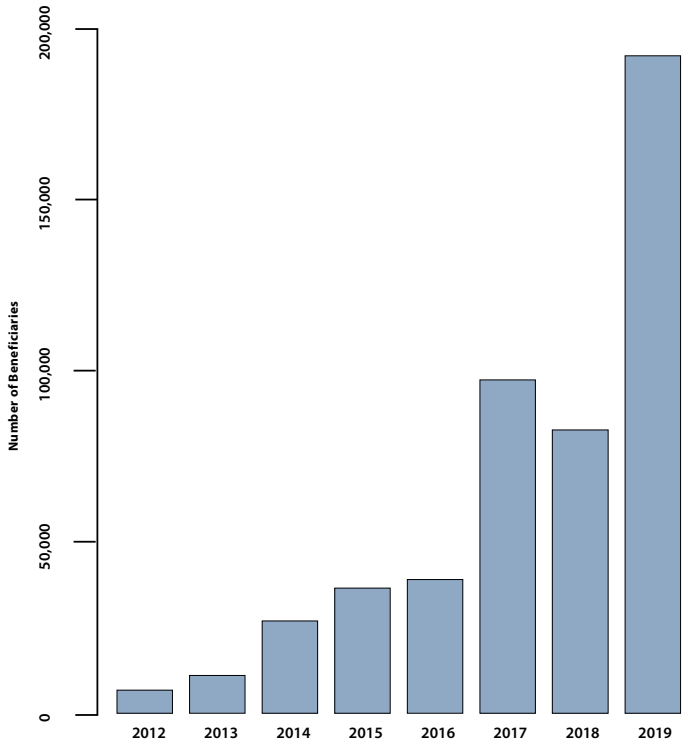

Figure 3. EORE beneficiaries per year (2012–2019).

The geographical distribution of EORE activities was consistent with the official categorization of the municipalities in accordance with their EO impact level, from type I (highest impact) to type IV (lowest impact), based on the number of victims in the last five years, the state of land restitution, the presence of illegal armed groups, and the presence of illicit crops. In fact, 93.6 percent of the EORE activities targeted type I and II municipalities, which are the most heavily affected. Figure 1 shows number of beneficiaries and victims by department.

Figure 4 shows the superposition of the beneficiaries (shades of blue) and the victims (red dots) for two periods (2012–2015 and 2016–2019). This information was desegregated by departments to show comparisons between the two periods (Table 3). The distribution of victims is similar in both periods, although in the first period there is a higher density of victims in departments such as Antioquia (north) and in the southern Pacific region (Nariño and Cauca), Putumayo and Caquetá—all regions highly-affected by the armed conflict. In the second period, there is a decrease in the number of victims and an increase in EORE activities, illustrated by areas highlighted in dark blue (higher number of beneficiaries). Both the proportion of activities in type I and II municipalities, as well as the increase in activities in recent years in the department of Nariño, show that activities in the most affected areas have been prioritized.

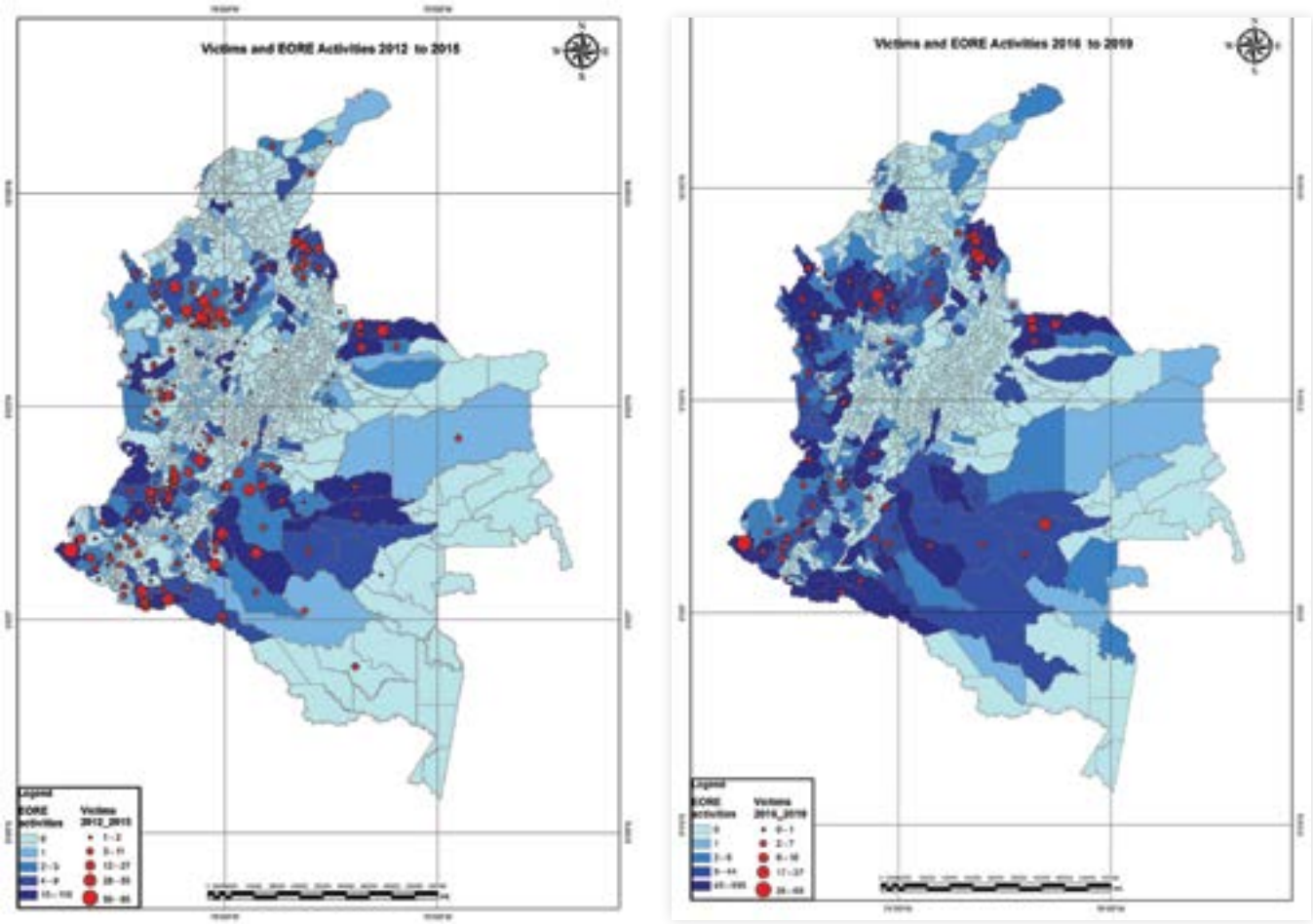

Figure 4. Number of victims and EORE activities geographical distribution during two periods: 2012 to 2015 (left) and 2016 to 2019 (right).

Department	*2012-2015*				*2016-2019*				*Total*			
	Victims	**%**	**Beneficiaries**	**%**	**Victims**	**%**	**Beneficiaries**	**%**	**Victims**	**%**	**Beneficiaries**	**%**
Antioquia	286	19	14,064	17	55	13	37,279	9	341	17	51,343	10
Nariño	217	14	3,754	5	106	24	87,217	21	323	16	90,971	18
Putamayo	164	11	4,797	6	7	2	20,871	5	171	9	25,668	5
Caquetá	156	10	4,267	5	13	3	14,678	4	169	9	18,945	4
Cauca	105	7	9,754	12	14	3	35,075	9	119	6	44,829	9
Norte de Santander	105	7	5,689	7	88	20	51,898	13	193	10	57,587	12
Meta	90	6	5,483	7	3	1	14,546	4	93	5	20,029	4
Auauca	82	5	4,889	6	41	9	42,178	10	123	6	47,067	10
Tolima	63	4	1,527	2	4	1	8,993	2	67	3	10,520	2
Chocó	59	4	3,488	4	36	8	37,082	9	95	5	40,570	8
Huila	54	4	1,023	1	4	1	8,517	2	58	3	9,540	2
Córdoba	45	3	1,633	2	7	2	8,287	2	52	3	9,920	2
Valle del Cauca	39	3	3,427	4	5	1	8,374	2	44	2	11,801	2
Guaviare	19	1	2,627	3	28	6	3,422	1	47	2	6,049	1
Bolívar	8	1	3,625	4	16	4	11,057	3	24	1	14,682	3
La Guajira	6	0	550	1	0	0	295	0	6	0	845	1
Vichada	6	0	34	0	0	0	140	0	6	0	174	0
Boyacá	5	0	658	1	1	0	2,066	1	6	0	2,724	1
Magdalena	4	0	36	0	0	0	142	0	4	0	178	0
Amazonas	3	0	0	0	0	0	414	0	3	0	414	0
Casanare	3	0	783	1	0	0	2,674	1	3	0	3,457	1
Bogatá DC	2	0	375	0	0	0	1,679	0	2	0	2,054	0
Santander	1	0	3,234	4	0	0	5,193	1	1	0	8,427	2
Vaupés	1	0	0	0	0	0	769	0	1	0	769	0
Atlántico	0	0	12	0	0	0	1	0	0	0	13	0
Caldas	0	0	3,072	4	0	0	2,956	1	0	0	6,028	1
Cesar	0	0	299	0	3	1	946	0	3	0	1,245	0
Cundinamarca	0	0	518	1	0	0	375	0	0	0	893	0
Guainía	0	0	0	0	0	0	68	0	0	0	68	0
Quindío	0	0	67	0	0	0	0	0	0	0	67	0
Risaralda	0	0	466	1	0	0	0	0	0	0	466	0
Sucre	0	0	573	1	4	1	4,039	1	4	0	4,612	1

Table 3. Comparison indicating number of victims and beneficiaries between departments over two periods. *Table courtesy of OACP-DC.*

Finally, Figure 5 shows the relationship between the number of EORE activities and victims, highlighting a change since 2016, where the curve flattened and maintained a flat trend. This indicates a decrease of the number of victims and an increase of EORE activities. Unfortunately, it is challenging to confirm a cause-effect relationship between the increase of EORE and the decrease of victims due to a lack of systematic monitoring of behavioral changes following EORE training. As Durham et al. (2005) pointed out, there are several factors (socio-environmental and political)[11] that influence human behaviors. In Colombia, factors related to socioeconomic disparities at the regional level may contribute to civilians engaging in unsafe behaviors. Some examples include the lack of equality in accessing education (mostly between rural and urban areas), which leads to a higher proportion of children not attending school nor receiving education on safe behaviors. Indigenous communities (widely affected by the conflict and extreme poverty) are often permanently displaced and may be difficult to access. Economic activities (rural) can also lead to unsafe behaviors as civilians must use the land or move around in dangerous areas.

CHALLENGES: EORE SCOPE AND PRIORITIZATION

The implementation of EORE actions in all contaminated areas is unfeasible in a country like Colombia due to the topography, accessibility, security issues, and distribution of contamination. Therefore, it is necessary to focus EORE efforts on the most heavily-affected and vulnerable zones. In this scenario, one option is to increase the number of participants per EORE activity according to specific criteria, such as belonging to high-risk categories (i.e., farmers and manual eradicators).[12] According to OACP-DC, municipalities are selected for EORE according to one of the following three reasons: (1) type I and II municipalities not open to humanitarian demining operations, (2) high-vulnerable municipalities due to history of significant armed conflict, and (3) municipalities where humanitarian demining is taking place.

However, in the case of the department of Nariño, a high number of victims correlates with critical socioeconomic issues. Therefore, this must be approached not only from a "number of victims" perspective, but also by taking into account aspects such as security issues, geographical characteristics that may affect mobilization, access to health services, cultural specificities, etc. This enables more context-specific interventions, acknowledging why current unsafe behaviors exist and what limitations can affect the expected behavioral change in the communities.

CHALLENGES: MONITORING AND EVALUATION

The NMAA has established EORE internal and external quality monitoring procedures. According to the current EORE national mine action standard (NMAS), a two-step accreditation process for EORE organizations is defined as (1) a preliminary accreditation called "authorization," which enables operations to start and (2) a full accreditation after having acquired a pre-defined minimum experience. In order to comply with the EORE NMAS, EORE organizations need to carry out an initial evaluation of their capacity, define an improvement plan, and then monitor the progress against that plan. The external quality assurance (QA) is carried out periodically by the NMAA.

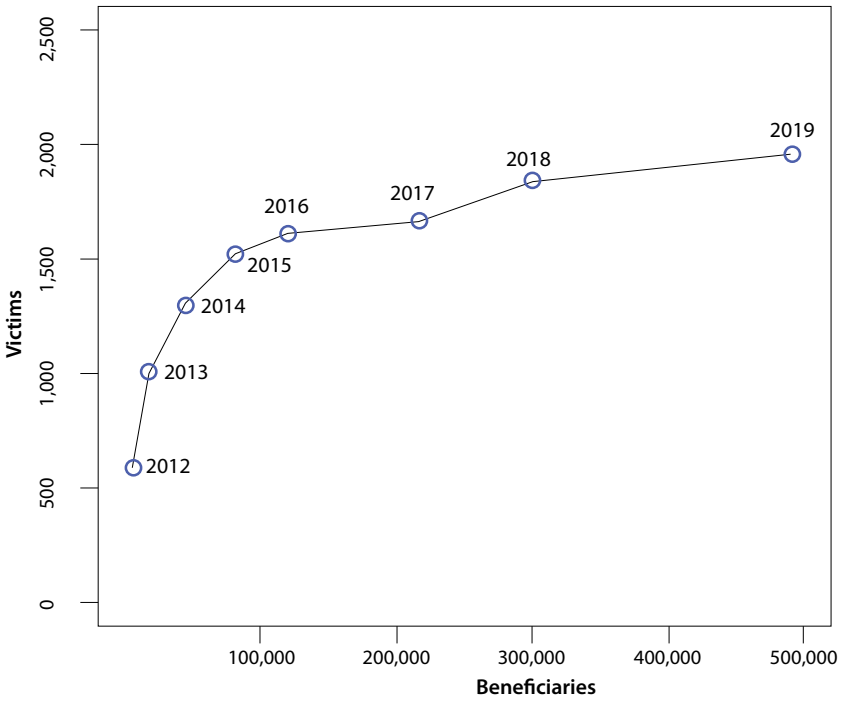

Figure 5. Correlation between accumulative number of victims and EORE activities.

One of the issues identified in the current QA process relates to the variety of organizations providing EORE (humanitarian NGOs, demining organizations, private foundations, and citizen organizations), resulting in very different capacities. Therefore, the standardized evaluation is currently applied with some flexibility according to each organization type, especially pertaining to community-based organizations (survivors, indigenous, and afro-descendant). As soon as all organizations are authorized to conduct EORE, monitoring shall take place to ensure the standardization of minimum practices in accordance with the implemented EORE model.

Finally, a clearly defined monitoring and evaluation strategy must be identified. Currently, this task is not being performed in a systematic manner. Therefore, standardized indicators at both strategic and operational levels should be defined, in addition to the construction of the baseline, and all data should be consistently gathered and reported to the National Authority. This data should help clarify how local populations are affected by EO and inform programs about trends or changes impacting the vulnerability of communities. Finally, the implementation of an evaluation system should be established in order to measure the real impact of activities, including an effective ethnical and gender-sensitive approach.

EORE MESSAGES AND DISSEMINATION METHODS

In addition to standard face-to-face EORE meetings, OACP-DC implemented alternative dissemination methods during the study period. Specifically, radio advertisement broadcasts were released in thirty-four municipalities of thirteen departments in 2015. In addition, a strategy named "Safe Steps" was implemented by the Fundación Antonio Restrepo Barco in collaboration with Discovery Channel, resulting in a mini-series with video-informative capsules and virtual strategies that were used to promote safe behaviors in EO-affected regions. Moreover, in order to overcome the challenge of defining standardized messages, a national technical board was arranged in February 2020 to review the pedagogical roadmap with adjusted and updated EORE messages, where inputs made by the involved organizations were discussed. Finally, the NMAA is currently working on the inclusion of a multicultural approach for EORE. This last aspect is necessary, considering that one of the objectives for 2020 is the construction of a guideline document for the implementation of EORE with an ethnically sensitive approach, which will be translated or adapted to native languages to facilitate its implementation in the field.[13]

LESSONS LEARNED

EORE activities in Colombia are performed in a coordinated manner between OACP-DC and EORE partners, technically supported by UNICEF. Technical support includes updating messages of the EORE pedagogical route and designing guidelines and other materials; updating the EORE standard and EORE models (educational field, humanitarian demining, and emergencies); and construction and implementation of the EORE Quality Management System (accreditation, certification, and quality control). Under this coordination, an EORE National Standard was constructed and updated, and EORE models were standardized. This understanding permitted experienced organizations, in accordance with the Colombian context, to use and implement proven experiences from other countries.

Since 2006, the NMAA conducted periodic technical meetings with all stakeholders performing, advising, monitoring, funding, or investigating EORE activities and educational institutions. This activity allowed all stakeholders to share best practices and innovative approaches, identify shortcomings, and reach agreements in order to standardize and continuously improve EORE in Colombia.

In Colombia, several areas highly affected by the conflict do not have stable security conditions necessary for the implementation of humanitarian demining operations. In these areas, EORE represents the first approach to reduce the risk of EO accidents, enable liaison with the community, and help to create the conditions for future humanitarian demining. Additionally, the presence of illicit crops, which is usually related to critical security issues, highlights the importance of delivering EORE sessions to manual crop eradicators and identifying the numerous risks they face, including a higher risk of accidents.

CONCLUSION

In the last few years, there has been a significant increase in EORE activities in Colombia, supported by an important standardization effort on all EORE models implemented in the country. Although information management of EORE data has improved, there is still

room for more systematic and consistent data gathering, recording, and analysis at both an operational and strategic level. Similarly, the lack of a monitoring and evaluation system prevents the quantification of the impact of the different EORE programs.

Evaluation of the correlation between EORE activities and the number of victims cannot be a quantitative task alone. Qualitative studies are also required to ascertain whether the expected change of behaviors has been achieved through methodologies previously implemented in countries like Afghanistan and Somalia.[14] Finally, the definition of a context-specific prioritization methodology for targeting specific areas and beneficiary groups is one of the main remaining challenges, strongly affected by the continually changing security conditions.

See endnotes page 67

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PROOF: How Small Drones Can Find Buried Landmines in the Desert using Airborne IR Thermography

By John Fardoulis [Mobility Robotics], Xavier Depreytere, Pierre Gallien, Kheira Djouhri, Ba Abdourhmane, and Emmanuel Sauvage [Humanity & Inclusion]

Image 1. An onus on proof—moving the needle under actual field conditions at 30-year-old legacy desert minefields in Chad.
All graphics courtesy of authors.

Hypotheses and speculation have circulated for at least three decades regarding how IR thermography could be viable as a technique for locating buried landmines in arid environments. However, there has been a lack of proof under actual field conditions.

To the best of the authors' knowledge, no previous research occurring before October 2019 validated how temperature anomalies could be identified under field conditions by small unmanned aircraft systems (i.e., drones) using thermal/long wave infrared (IR or LWIR) imaging, also known as thermography, to indicate the location of buried anti-personnel and anti-tank landmines in legacy desert minefields. Evidenced-based and field driven, Mobility Robotics and Humanity & Inclusion (formerly Handicap International, HI) established new, state-of-the-art knowledge in October 2019 regarding the use of small drones in humanitarian mine action (HMA). Airborne data collected via drones indicated the position of more than 2,500 legacy, in-situ landmines in Chad.

Addressing many overall questions regarding small drones in HMA, the Odyssey2025 Project—led by HI and Mobility Robotics—closely collaborated with the national mine action center in Chad, the Haut Commissariat National au Déminage (HCND), to complete activities and objectives. As part of a holistic approach, the primary objective was to determine how small drones could add value in HMA field operations and augment other assets at both simple and advanced perspectives. This research is from an advanced perspective, following on from the work previously published in *The Journal of Conventional Weapons Destruction* outlining how low-cost consumer drones can augment HMA operations at a simple level using visual imagery and GIS/cartography/photogrammetry.[1]

This article aims to advance the field's understanding of drones and their ability to indicate the location of buried objects. Elements that set this work apart from other drone and thermal/LWIR research over recent years include:

1. a concentration on buried objects;
2. the capturing of in-situ airborne data at active, legacy minefields;
3. the burying of production landmines containing real explosives to capture high temporal resolution data at a controlled field test site;
4. an onus on proof in a harsh, remote, real-world environment—incorporating local weather and environmental influences—that

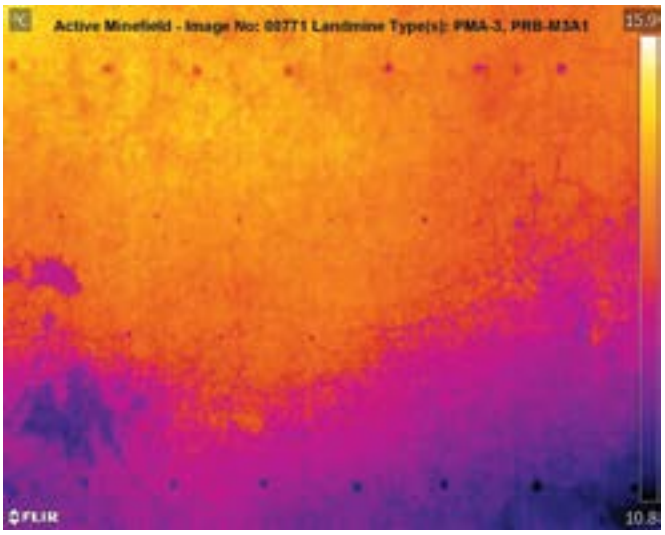

Figure 1. In-situ minefield data captured by a small drone from a height of 35 m above ground level (AGL) in Chad. Anomalies from twenty-seven legacy buried landmines are visible in this thermal/LWIR image. Thirteen PRB-M3A1 anti-tank landmines are in rows at the top and bottom. Fourteen PMA-3 anti-personnel landmines are in the two middle mine rows.

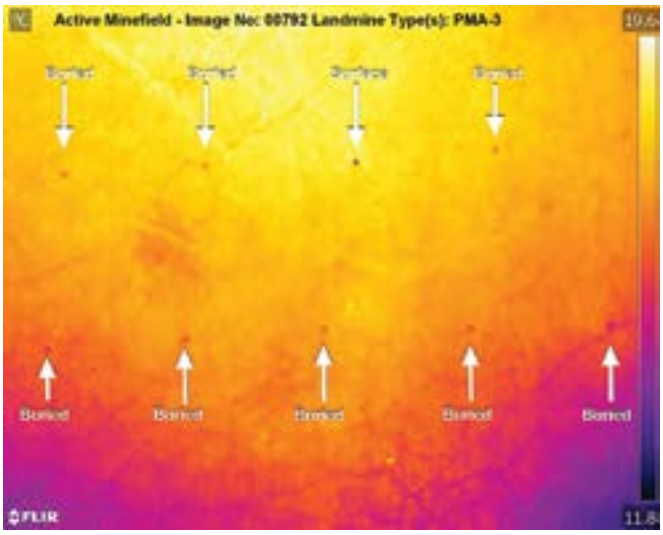

Figure 2. Above, anomalies from nine PMA-3 anti-personnel landmines can be seen from a flying height of 25 m AGL in this thermal/LWIR image. The PMA-3 is cold when on the surface at night (darker surface dot above), whereas the PRB-M3A1 and PPM-2 are warm when interfacing with the air at night.

provides validation under actual field conditions; and

5. the applied activities that took place with HMA actors to develop a practical, real-world methodology that achieves a humanitarian impact.

HYPOTHESIS

Buried landmines interfere with how temperature is stored in and travels through the ground, creating hot or cold patches on the surface above buried objects. The different surface temperature above the buried landmine is an anomaly, an indicator of where contamination exists beneath. The strength and timing of when a hot or cold patch appears during the day or night depends on many complex weather and environmental variables at the time.[2–6]

HMA SCOPE

Presently, the scope of thermal-camera-equipped drones in HMA is to use them as a survey tool and during planning and evaluation phases, to better define the types of landmines present, locations of mine rows, and contamination densities in arid (and perhaps semi-arid) environments. Operating from a safe distance outside of the minefield, users can leverage drone technology to pinpoint where buried landmines exist in order to more effectively and efficiently use ground assets such as manual deminers and animal/mechanical assets. By first mapping patterned minefields, operators can apply lessons learned to deal with more complex minefield layouts. Drone technology is a survey tool, which does not work in isolation, so missing some landmines is acceptable as the missing objects will be found by ground teams when they undertake technical survey or clearance work.

A challenge in HMA is pinpointing where contaminated areas are located within larger suspected hazardous areas (SHAs). Systematic approaches across a general area are necessary for safety but can mean that millions of dollars are spent sending ground assets to areas where landmines do not exist. Starting clearance from where landmines exist and working from the inside of a minefield outward, operators can potentially reduce the size of work areas where ground assets are deployed. Hence, there is potential for drone technology to reduce costs, accelerate land release, and improve safety in arid and perhaps semi-arid environments.

MATERIALS AND METHODS

The Odyssey2025 Project included the following field validation and data collection elements:

1. Field validation regarding the viability of airborne IR thermography involved remotely collecting in-situ landmine data via drone over legacy minefields during the hot and cold seasons of October 2019 and March 2020 respectively.
2. High temporal and spatial resolution data was captured at a controlled field test site using production landmines recovered from surrounding minefields (minus fuzes). These mines were buried at known depths inside the perimeter of actual minefields (Figure 3b). The controlled field test site continuously captured data at one-minute intervals over more than four 24-hour daily cycles during the cold season in March 2020.

TEST LOCATIONS

Fieldwork took place at minefields in the Sahara Desert, northern Chad, 280 km from the southern Libyan border (Figure 3a). The three main landmine types present at these locations were all minimum metal types: PMA-3 anti-personnel, PPM-2 anti-personnel, and PRB-M3A1 anti-tank landmines. Additionally, NR-109 trip flares and a smaller number of metallic NR442 bounding anti-personnel landmines were present.

AIRBORNE DATA

In October 2019, most flights over minefields started before 4:00 a.m. and continued until sunrise. Flying at night was preferred during the

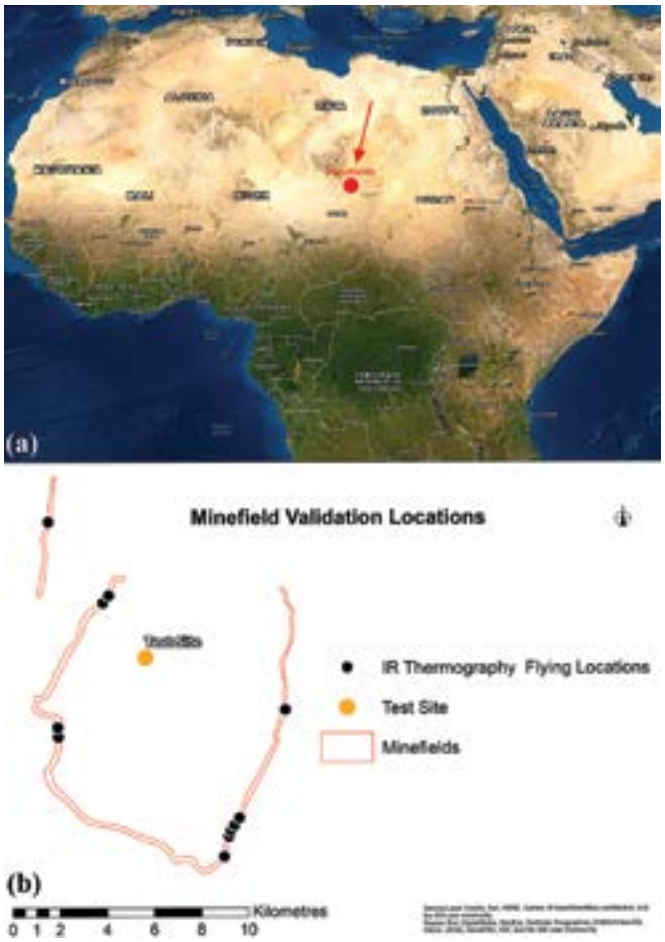

Figure 3(a). The arrow and red marker show the location of the minefields where work took place in the Sahara Desert, 280 km south of the Libyan border with Chad.
3(b) The minefield perimeter area and ten different flying, field validation locations. Also the location of the test site, within a 10 km radius of active, in-situ legacy minefields.

colder March 2020 period, an hour after sunset, until 10:00 p.m. This was because variability in seasonal conditions seemed to determine when anomalies would appear strongest to the thermal cameras.

Data was captured from ten different legacy minefield locations to cover a variety of natural conditions and landmine types. Several of these locations were revisited at different times of the day and night during both seasons.

A form of minefield ground-truthing methodology was developed using visual and thermal/LWIR imagery together. Mine rows were laid using traditional military tactics and often appeared in linear patterns. To validate that anomalies were from landmines, researchers flew drones over locations where rows of surface mines were visible from erosion and then directed the drone flight left or right along that line, where buried landmines were not visible to the naked eye. This method provided confidence that anomalies captured in thermal/LWIR data represented buried landmines (Figure 4). Mine row patterns were followed by flying along thermal anomalies using a scouting methodology (following the anomaly dots in real time) to make judgement calls regarding the extent of contamination and where minefield borders may be located. MAG (Mines Advisory Group) also provided researchers with data from past clearance operations, which

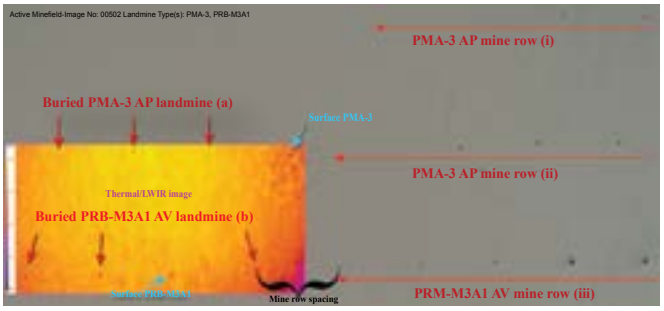

Figure 4. Above shows an example of ground-truthing or visual validation from outside of the minefields. A thermal/LWIR image from the small drone is joined to a high-resolution daylight image. The same pattern continues in mine rows (a) and (b), after surface landmines are no longer seen from mine rows (ii) and (iii). Sub-surface anomalies maintained the same horizontal spacing and object size as for landmines exposed on the surface (from erosion). With high-resolution, small-drone daylight imagery, we could identify the type and model of each mine on the surface in mine rows (i)–(iii). This taught us how to interpret thermal anomaly signatures and identify specific local patterns then progress in finding anomalies from buried mine rows without the need for patterns on the surface as a starting point.

noted the models of landmines found in the area and how they were laid in patterns, at set distances from each other.

CONTROLLED FIELD TESTING

A grid of 80 x 80 cm boxes was established at the field test site, where production landmines, landmines free from explosives (FFE), and a range of different simulant designs were buried for comparison.

A thermal/LWIR camera[7] was mounted on a 7-meter-high mast, with a field of view of sixty-six boxes, which captured images every minute. Thermocouple probes with data loggers that captured information at two-minute intervals were buried at different depths above, away from, attached to, and inserted inside landmines.

EQUIPMENT AND SOFTWARE

Commercially available equipment and sensors were utilized. A DJI FLIR Zenmuse XT[8] thermal/LWIR camera with a 13 mm lens, 640 x 512 pixel resolution, and radiometric data capture capabilities was attached to the drone. An additional thermal/LWIR camera/sensor with almost identical capabilities, the FLIR Duo Pro R,[7] was also purchased for the controlled test site. The small drone used was an industrial (not consumer) model: an off-the-shelf DJI Matrice M210 v2 quadcopter[9] (Image 3). The same software and similar procedures were utilized for data processing and storage as those for visual imagery.[1]

Image 2. Setting up the controlled field test site to bury: production, FFE, and simulant landmines from where IR thermography data was automatically captured at one-minute intervals, 24-hours a day.

Image 3. Fieldwork at remote, in-situ Sahara Desert minefields using a small industrial model, off-the-shelf, DJI Matrice M210 v2 quadcopter with advanced sensors.

RESULTS

Characterizing Thermal Anomalies. The sand surface was noisier during the day from the effect of sunshine when anomalies from buried landmines were warmer than the surrounding sand. Hence, colder thermal anomalies are presented in airborne IR thermography data captured at night.

Different in-situ signatures were recorded via drone-mounted thermal cameras for the three main types of landmines present. At night, each produced a cooler buried anomaly, with the PPM-2 and PRB-M3A1 appearing warmer than the sand when exposed to the surface. However, the PMA-3 was cooler than the surrounding sand when exposed to the surface (Figure 2, Figure 4).

The cylindrical pressure plate (PP) of the PRB-M3A1 displayed different thermal characteristics than its square plastic body containing 6 kg of explosives. The PP was colder than the body area when buried but warmer than surrounding sand if very close to the surface or partially exposed (Figure 5, Figure 6).

Image 4. The PRB-M3A1 landmine, which showed different thermal anomaly characteristics from the pressure plate than the square plastic body filled with 6 kilograms of explosives.

Natural objects such as stones and manmade objects did not create too much noise in competing with anomaly signatures from buried landmines (Figure 9). Airborne IR thermography was effective in also locating secondary indicators, such as metal posts which were internal minefield reference markers indicating how mine rows were laid.

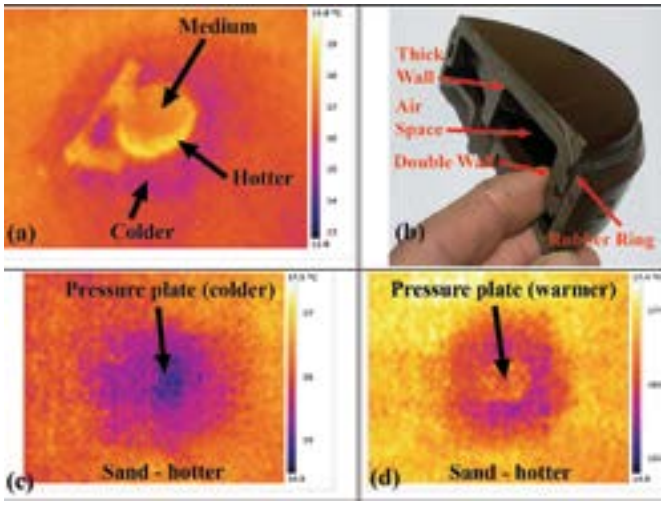

Figure 5. Small drone flying data showing thermal signature characteristics of a PRB-M3A1 AV landmine (Image 4). Thermal characteristics of an in-situ partially buried PRB-M3A1 can be seen in (a). At night, a ring around the pressure plate is hotter when interfacing with the air. See (b) for a cross section of a pressure plate to understand why. In (a), parts of the plastic body exposed to the air are warmer, and sections of the body interacting with the sand, including 6 kilograms explosives are cooler. Different thermal anomalies from another two buried in-situ PRB-M3A1 landmines are shown in (c) and (d), where (c) is deeper because the pressure plate anomaly is colder than for the square body of the landmine, and (d) is shallower and very close to the surface as the pressure plate anomaly is warmer than from the body. However, (d) is not exposed very much because a hotter ring around pressure plate like (a) would be evident if interacting with the air.

Optimal Flying Height. Data was captured from heights of 3 m (Figure 5) above ground level (AGL) to 100 m AGL. The maximum effective range at which these anomalies could be identified was from a flying height of 80 meters AGL for buried PRB-M3A1 anti-tank landmines, and at 30–35 m AGL for PMA-3 anti-personnel landmines. Greater efficiency is gained by flying higher because a larger footprint is captured in each image and the drone can fly faster, covering more ground per unit of energy. Figure 7 shows anomalies from nine buried landmines in a footprint captured from the sensor at 20 m AGL, compared to Figure 1 showing twenty-seven anomalies in a footprint captured by the sensor at 35 m AGL. A more extreme example can be seen in Figure 8 at a height of 55 m AGL. Twenty-four anti-tank landmine anomalies appear across the top and bottom rows. From the pattern in that location, we know that there are two anti-personnel mine rows in the middle with similar spacing. Hence it is not unreasonable to infer that around forty-eight anomalies exist in this thermal/LWIR image.

Optimal flying heights would need to be reviewed by season or perhaps on individual days according to the strength of anomalies.

Controlled Field Testing. The controlled field test site captured quantitative data regarding the impact of a diurnal cycle, weather, and the local environment. One of our main objectives was to determine

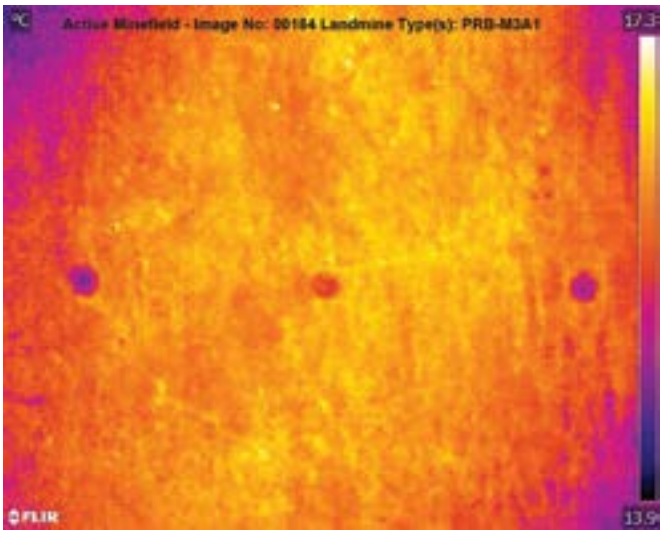

Figure 6. Proof that the tool works. Above is an airborne thermal/LWIR image of anomalies from a height of 10 m AGL. This indicates the location of three buried in-situ PRB-M3A1 anti-tank landmines. Close examination will show different thermal responses from cylindrical pressure plates in the middle of each anomaly. This is different to how the square plastic body containing 6 kg of explosives reacts with the environment.

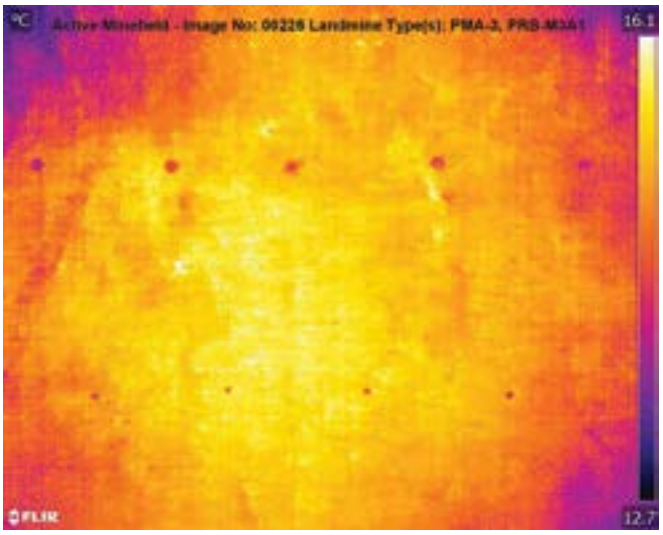

Figure 7. The thermal/LWIR image above was captured over active, legacy minefields from a height of 20 m AGL. Anomalies from five PRB-M3A1 anti-tank landmines can be seen at the top, and four PMA-3 anti-personnel landmine anomalies at the bottom. Nine landmines are in this footprint.

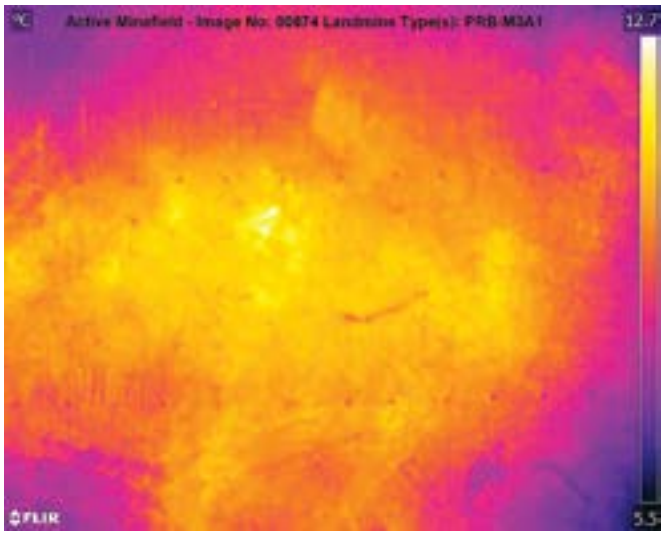

Figure 8. Above, a thermal/LWIR image from a height of 55 m AGL. It is too high to see the anti-personnel landmine thermal anomalies in the middle two rows but enough resolution exists to see twelve anti-tank anomalies in each of the top and bottom rows. Assuming a similar number of anti-personnel landmines exist in the two middle rows, that makes around forty-eight anomalies in this thermal/LWIR image. It provides a good idea regarding where the edges of mine row borders are located.

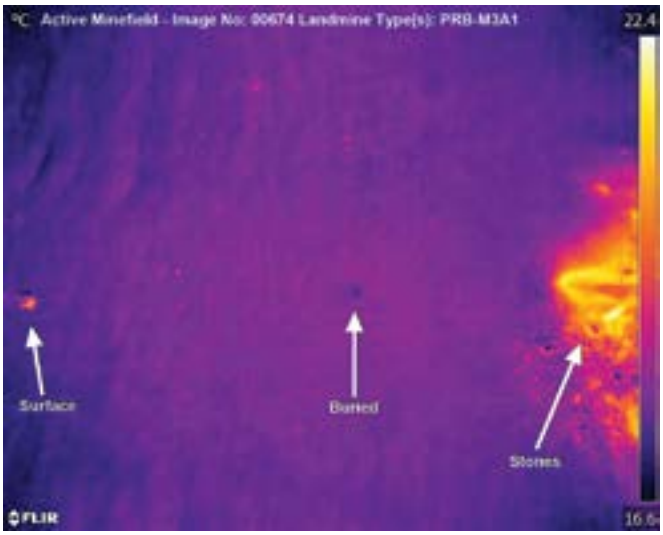

Figure 9. above is an example of how stones appear from airborne in-situ thermal/LWIR data. In this case, surface and buried landmines could still be identified at night.

Image 5. Our reference PMA-3 anti-personnel landmine was buried at a depth of 1 cm. It is shown above after excavation at the end of the study. The type of sandy environment can also be seen.

which times to fly the small drone. The following are some of the highlights based on a reference PMA-3 anti-personnel landmine (Image 5). The reference landmine provided a trackable benchmark over time to provide observable differences that weather and environmental variables made on anomaly signatures captured by the thermal/LIWR camera. It also provided a benchmark to compare against anomalies from other landmine models and simulants buried at different depths.

Optimal Timeframe. Table 1 is a summary of anomaly strengths captured by the thermal/LWIR cameras over eleven different time slots during more than four 24-hour diurnal cycles. Captured under actual field conditions, the fifty-two data points presented in Table 1 take into account every single variable at the time. Sunrise was at around 6:00 a.m., with sunset at around 5:30 p.m. The test site data in Table 1, Figure 10, and Figure 11 confirmed that a 2.5-hour period pre-dawn and up to 4 hours post-dusk were the best operating times, meaning night was the optimal time to search for anomalies.

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Influence of the Clouds, Sun, and Wind. Cloud cover seemed to reduce how noisy the sand surface appeared to the sensor during the day, likely because of diffused reflectance from the sun. Data in Figure 12 from 9:00 a.m. on Day 3 and 9:00 a.m. on Day 6 indicates that the anomony from the reference landmine is noisier on a sunny day compared to a cloudy day. However, there was more wind on the sunny day, which could have a combined effect.

We found that the wind had an impact on the strength of thermal anomalies from buried landmines captured by the sensor. Figure 11 shows more detailed examples from the Table 1 summary, quantifying the strength of the thermal anomaly captured from our reference PMA-3 antipersonnel landmine at 10:00 p.m. each night, over

Time	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
2:00 a.m.		Weak	Weak	Weak	Weak	Medium
3:30 a.m.		Strong	Strong	Weak	Medium	Medium
5:00 a.m.		Strong	Strong	Weak	Weak	Medium
9:00 a.m.		Medium	Strong	Weak	Medium	Strong
12:00 p.m.		Weak	Not Visible	Not Visible	Not Visible	
2:00 p.m.		Weak	Not Visible	Not Visible	Not Visible	
4:00 p.m.		Weak	Not Visible	Not Visible	Weak	
6:00 p.m.	Strong	Strong	Medium	Medium	Medium	
8:00 p.m.	Strong	Strong	Medium	Weak	Strong	
10:00 p.m.	Strong	Strong	Weak	Not Visible	Strong	
12:00 a.m.	Medium	Strong	Weak	Weak	Medium	

Table 1. PMA-3 reference landmine anomaly strength over eleven time slots during more than four 24-hour diurnal periods.

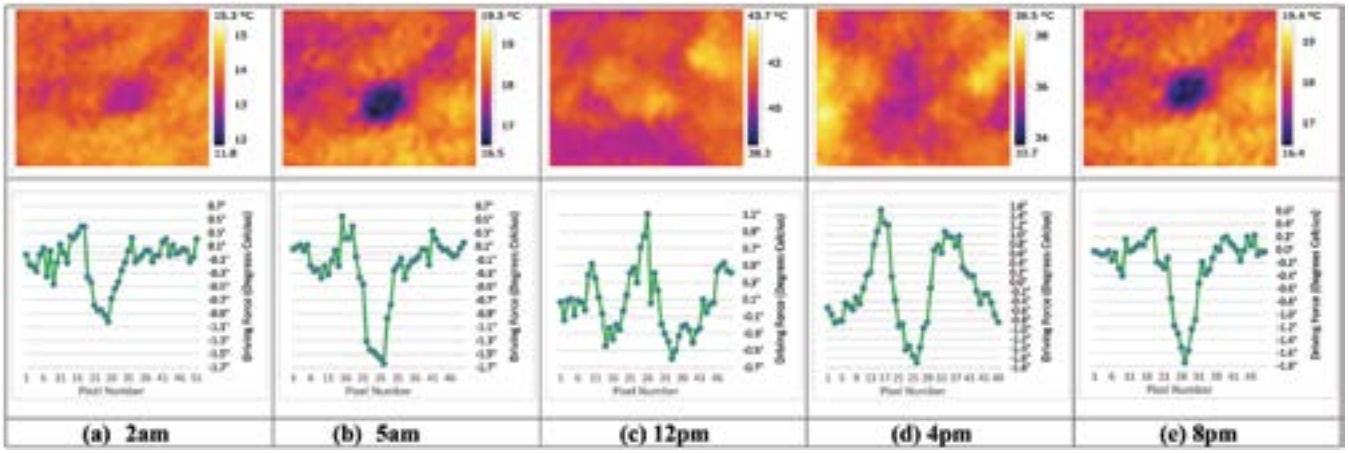

Figure 10. Above is data showing thermal anomalies during different times of the day and night (diurnal cycle) from Day 2 (Table 1) of our PMA-3 reference landmine. Thermal anomalies at night: pre-dawn at 5:00 a.m. (b) and post dusk at 8:00 p.m. (e) are stronger and clearer, which supports findings in Table 1 and Figure 11 that a few hours pre-dawn and post-dusk are the best operating times. Anomalies captured by the test site sensor at 2:00 a.m. (a), 12:00 p.m. (c) and 4:00 p.m. (d) are weaker and not very clear. Graphs show a surface cross section of the difference in temperature between the anomaly, and plain sand around it (driving force).

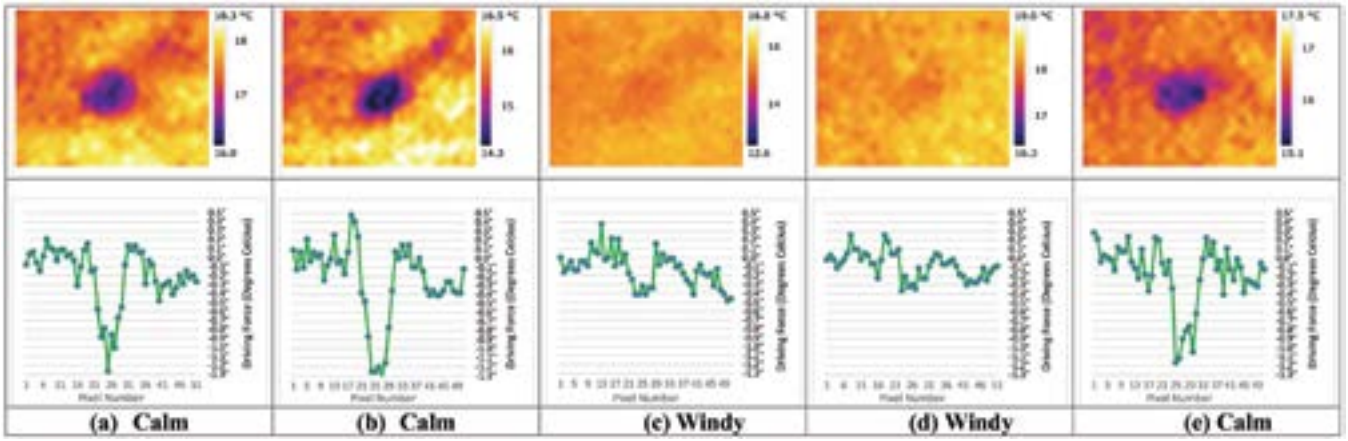

Figure 11. Above is test site data showing the impact of wind: using anomalies captured from the PMA-3 reference landmine, as an example at 10:00 p.m. each night over five consecutive nights. Conditions were calm on Days 1 and 2, with the wind picking up at 12:00 p.m. on Day 3 and dropping off at 8:00 p.m. on Day 5 (Table 1, Figure 10). Hence, it was calm on the first, second, and fifth nights (a), (b), and (e), but windy during the third and fourth nights (c) and (d). The data shows that the strength of the anomaly was affected by the wind, with the clarity of the anomaly captured by the sensor dropping or disappearing at windy times. This proves that the viability of such a potential new tool can vary by day, depending on the local weather and environmental conditions. Graphs show a surface cross section of the difference in temperature between the anomaly, and plain sand around it (driving force).

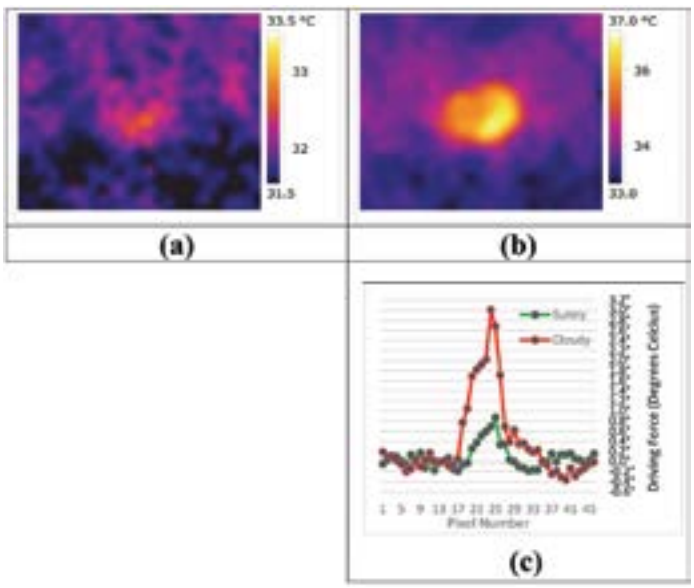

Figure 12. Anomalies from our PMA-3 reference landmine at 9:00 a.m. when it was sunny (a) and cloudy (b). Numbers in the driving force graph (c) look better for (a) than the image suggests, as data seemed noisiest when it was sunny. There was also a combination of less wind, plus clouds in (b), meaning compounded variables.

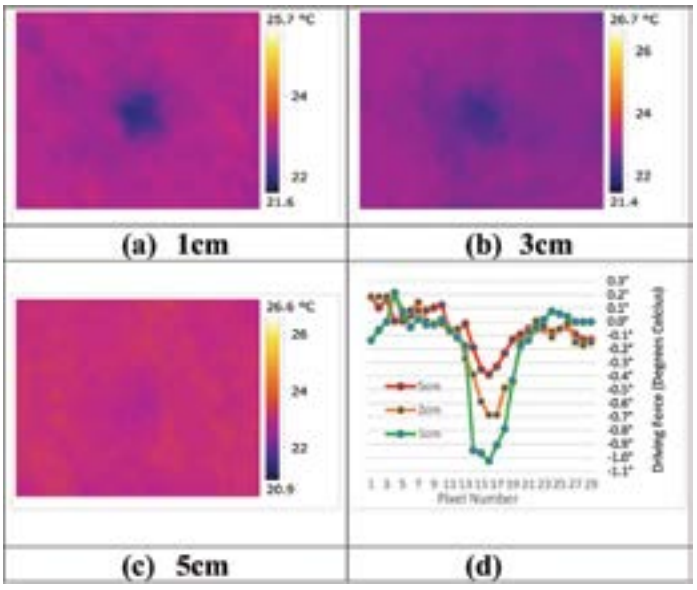

Figure 13. Above is test site anomaly data from three different PMA-3 AP landmines buried at 1 cm (a), 3 cm (b), and 5 cm (c) depths during one of the better nights. (d) graphs the strength of each of (a)-(c) anomalies compared to sand's natural surface temperature.

five nights. The anomaly was clearly visible during calm times but was weak or not visible to the sensor when the wind increased (Figure 11). Table 1 shows the anomaly strength over many other time slots, with variability being affected by the wind on Days 4 and 5.

Impact of Depth. Figure 13 shows that the strength of anomalies reduces by landmine burial depth. The 3-cm-deep anomaly can be seen in the raw thermal/LWIR image but the anomaly from a 5 cm depth cannot be seen in the original thermal/LWIR image. A weak anomaly from the 5 cm depth can be seen in data exported in Figure 13(d), which might be improved with post-processing.

Overall, landmines at in-situ legacy minefield locations seemed to create more significant anomalies than the test site, which could be intensified after a much longer settling time in the ground and if an optimal

Image 6. Camping and working at night in the desert, surrounded by minefields is not an easy feat. At least ten skilled HMA personnel were required to support each campaign in the field and to ensure safety.

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amount of moisture had built up. More fieldwork data, ideally including simultaneous in-situ excavation at legacy minefields (covering every variable) is required for better estimates of the maximum viable depth.

DISCUSSION

The emphasis of this article is to prove how small drone IR thermography was an effective HMA tool in the Sahara Desert, northern Chad. Data collection and validation occurred under actual field conditions, in one of the most extreme environments on the planet—working in confirmed hazardous areas (CHAs), in a red zone, with the challenges of camping and operating reliably in extreme conditions, in between sandstorms, offline, at night, and with minimal infrastructure. At least ten skilled HMA personnel were required to support each campaign in the remote locations visited, and to ensure operational safety.

We have shown evidence of how anomalies from anti-personnel and anti-tank landmines captured using IR thermography from a small drone at legacy minefields can be used as an effective survey technique to estimate the location of such buried objects. Proof can be seen in ten examples of airborne thermal/LWIR data: Figures 1, 2, and 4–9.

We have shown that performance-affecting factors are flying height, physical properties of individual landmines, diurnal elements, burial depth, the sun, the wind, and possibly cloud cover. Ground water content and moisture are variables to consider in the future. Anecdotally, seasonal differences (hot vs. cooler season) appeared to make a difference. We suspect that temperature is the driving force causing this, so the time of the year with the greatest differences between day and night temperatures is most likely to give the greatest visualization.

We have shown that in the field, multiple environmental and weather parameters are at play, each with different traits. Variability in weather conditions can affect an individual site by day. We found that high-resolution off-the-shelf sensors[7,8] were effective in capturing thermal anomalies from buried landmines. A micro drone with an integrated lower-resolution thermal sensor[10] was tested and found to be inadequate.

We have summarized findings to suggest that optimal operating times at locations in the Sahara Desert are at night. During optimal operating times, anomalies from buried landmines at locations visited in northern Chad were quite clear and did not require post-processing or deep-learning techniques for data to be useful. More information is required, ideally including simultaneous excavation at legacy in-situ minefields to determine the maximum landmine burial depth at which thermal anomalies can be identified.

A review of existing knowledge regarding IR thermography for locating buried landmines was made, ascertaining what was considered to be state-of-the-art. Our applied research built upon this to generate a new state-of-the-art in thermal/LWIR knowledge, which is hoped to become an initial starting point for future researchers. Mobility Robotics and HI learned practical lessons, with additional datasets in hand that will enable more specialized studies, extending beyond the scope of this introductory article.

We have visualized fifteen different anomalies in Figures 6-13 and analyzed fifty-two different anomalies in Table 1 from production landmines buried at our field test site. We have seen that thermal anomaly signatures can vary by each model of production landmine located at in-situ, legacy minefields, meaning that generalizations may not be accurate. We have also learned how to interpret nuances associated with each anomaly.

Lessons from the field suggest a weakness in general knowledge regarding landmine materials analysis from a thermographic perspective, particularly regarding the impact of materials such as rubber coatings and mechanical construction differences. Past work requires updating in the area of landmine simulant design.[11–14] The use of airborne IR thermography could be extended to locate buried unexploded ordnance (UXO) and explosive remnants of war (ERW), utilizing the same test site methodology to verify optimal operating parameters by depth, object properties, diurnal cycle, environmental, and weather conditions. Such methodology could also be adapted for use in other sectors, such as archaeology, to define optimal operating parameters in finding buried objects.

CONCLUSIONS

This project proved that airborne IR thermography can be used to locate buried landmines from small drones in Sahara Desert minefields. We found that the strength of thermal anomalies can vary by day, indicating that generalizations cannot be made without more field data to substantiate claims. Ideally, this would be undertaken across many arid and semi-arid locations in different countries contaminated with landmines. Regarding IR thermography research for HMA in general, the first, second, and third priorities should be more data collection under actual field conditions either at or within a close proximity to legacy minefields.

Based on lessons learned from mapping more than 30 linear km from small drones with regular daylight cameras in the same region, IR thermography is not the only option. It can be a less effective tool in some circumstances such as in mapping surface landmines in an arid environment.

FUTURE WORK

Priority areas regarding future work include different opportunities:

1. Dissemination, advocacy, and greater analysis to capitalize on the tens of thousands of data points captured and help the HMA sector gain confidence in such a tool; and
2. Leveraging new, state-of-the-art knowledge in IR thermography as a launch pad for real-world trials in other locations.

Opportunities regarding automated data processing such as deep learning and machine vision will also be investigated in order to leverage the impact of data in-hand from legacy minefields. Real-world minefield data is required to train algorithms with accurate thermal/LWIR anomalies from specific models of production landmines, captured under local environmental and weather conditions. A lack of accurate real-world training data is currently a limiting factor for automated data processing research.

Ideally, a range of HMA actors joining the research effort to accelerate momentum in moving the needle even further would substantially benefit the field's knowledge of thermal/LWIR techniques for HMA, as duplicative work will only delay gains in community expertise. Additional follow-on articles could be authored to leverage the impact of an

unprecedented amount of field data captured in Chad. Themes include

1. a more technical discussion of the underlying science and more granular anomaly analysis, comparing theory and reality in more detail;
2. a step-by-step guide on how to set up a controlled field test site to determine the feasibility of IR thermography for locating buried landmines, ERW, and other objects in each region;
3. a more detailed review of individual variables: natural, weather, object materials, diurnal cycle and geophysical elements from an extensive amount of data in-hand;
4. theory and reality in simulant and surrogate landmine design: based on real-world thermal anomaly signatures from the field; and
5. sharing lessons learned regarding risk-mitigation and operating procedures, e.g., extreme fieldwork conditions, and reliably operating small drones at minefields at night.

If funding, logistics, and permissions can be secured, an ideal supplementary project to accelerate momentum in moving the needle even further would be to develop a standard field test kit and establish controlled test sites in arid and semi-arid environments with a range of HMA partners in many other regions. For more information, including flying videos and sample data see www.mr-au.com/chad.

See endnotes page 67

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John Fardoulis is a scientist, remote-sensing practitioner, and aerospace engineer specializing in methodology design, field deployment, capacity building, and applied research into the use of small drones for humanitarian purposes in hazardous environments. He was the small drone specialist on the HI Odyssey2025 Project in Chad. Fardoulis has a bachelor of business from the University of Western Sydney and a MSc in Aerospace Engineering from the University of Bristol.

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Pierre Gallien is an agronomist with complementary training in management, epidemiology, and strategic foresight. During his twenty-five-years' of experience in the humanitarian field, he has held many technical (technical coordinator, Head of Knowledge Management division) and operational (geographical manager, mission director) positions for Action Against Hunger, Solidarités International, and HI.

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Director of the Armed Violence Reduction Division
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Emmanuel Sauvage has an industrial logistics management background and began working in humanitarian action in 1994 in the former Yugoslavia. He first joined HI in 2002. For the past seventeen years, Sauvage has held senior and advisory positions for HI and other international organizations/agencies in the field of humanitarian mine action and armed violence reduction. He has had direct exposure to information management, QA/QC, land release (clearance and surveys), risk education/management, and victim assistance and advocacy.

ENDNOTES

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Operationalized Management Information Systems in Iraq's DMA by Steyn and Claassens [from page 12]

1. Country Profile 2019: Iraq. *Landmine and Cluster Munition Monitor*, ICBL-CMC, November 16, 2018. https://bit.ly/2FJr7On.
2. Al-Khaledy, A. (2020, July 23). Hazard Area Summary Statistics for RMAC-S. (M. Steyn, Interviewer).
3. Steyn, M. (2018, Oct 1). RMAC-S Field Map App Design Guidelines. Basra, Iraq.

On-the-Ground Information Management Tools in Northeast Syria by Nyamwaya and Ndegwa [from page 15]

1. Clusters within the various groups include water rehabilitation and distribution (water tracking, installation of water systems, distribution of buckets, water taps, etc.); hygiene (hygiene awareness messages, kit distribution); sanitation (installing and maintaining of latrines, environmental sanitation of camps, solid waste management).
2. iMMAP Dashboard.
3. Turkish Operation Peace Spring is a military operation in northeast Syria which started on 9 October 2019 with the sole purpose of securing control of a large strip of territory in the region. The attack was aimed at removing Kurdish fighters from the border region and establishing a "safe zone" to resettle refugees in Turkey.
4. The MASC is a working group for all NGOs providing MA services.
5. Clearance organizations include TetraTech, MAG, HAMAP, and RISF (Raqqa Internal Security Force).

International Mine Action Standard 10.60 ("Safety & occupational health – Investigation and reporting of accidents and incidents")—Notes on the Revised Second Edition by Evans [from page 19]

1. MAG (Mines Advisory Group), The HALO Trust (HALO), Norwegian People's Group (NPA), International Committee of the Red Cross (ICRC), Humanity & Inclusion (HI), Directorate of Mine Action Coordination (DMAC), Tetra Tech, Center for International Stabilization and Recovery (CISR), Office of Weapons Removal and Abatement in the U.S. Department of State's Bureau of Political-Military Affairs (PM/WRA)
2. IMAS 10.60 Safety & occupational health - Reporting and investigation of demining incidents, mineactionstandards.org, accessed 30 September 2020, https://bit.ly/3n6ZTCs.
3. The distinction between a mine incident and/or accident and a demining incident and/or accident can cause confusion. The key difference is the location of the event. If it happens at a demining workplace, i.e., a clearance site, it is a demining incident and/or accident. If it happens away from a demining workplace, it is designated mine incident and/or accident. The relevant definitions can be found in https://bit.ly/34gIIqA.

The Mine Free Sarajevo Project by Trlin, Becker, and Uršič [from page 23]

1. "Current Mine Situation/Action/Report." Bosnia and Herzegovina Mine Action Centre. Accessed 30 October 2020. http://www.bhmac.org/?page_id=747&lang=en.
2. "IMAS 07.11 Land Release," Mine Action Standards, 10 June 2009, Amendment 5, February 2019, https://bit.ly/3lfrmRv.
3. Specifically IMAS chapters 08.10, 08.20, 09.10 and 09.11 are all related to land release.
4. "IMAS 04.10 Glossary of mine action terms, definitions and abbreviations," Second Edition, 01 January 2003. Accessed 30 October 2020. https://bit.ly/3jtTtdY.

Weapons Marking and Registration in Bosnia and Herzegovina: A Model for a Regional Approach to SALW Life-Cycle Management in the Western Balkans by Newton [from page 27]

1. Sustainable Development Goal 16: Promote just, peaceful and inclusive societies, https://sdg-tracker.org/peace-justice.
2. "Common Security and Defence Policy Eufor Operation Althea," European Union External Action, http://www.euforbih.org/eufor/images/pdfs/EUFOR_Mission_Factsheet.pdf.
3. "The Small Arms and Light Weapons (SALW) Control Strategy In Bosnia And Herzegovina (2016-2020)," United Nations Development Programme, http://msb.gov.ba/PDF/SALW_ENG%20FINAL_web.pdf.
4. South Eastern and Eastern Europe Clearinghouse for the Control of Small Arms and Light Weapons (SEESAC), "Roadmap for a Sustainable Solution to the Illegal Possession, Misuse and Trafficking of Small Arms and Light Weapons (SALW) and their Ammunition in the Western Balkans by 2024," https://www.seesac.org/publications-salw-control-roadmap/.
5. Ibid, p 8.
6. J. Carapic, B. King, BiH Regulatory Refinement Analysis, Small Arms Survey, 2017, p 7.
7. Small Arms Survey, "Research Notes, Measures and Programmes: Lessons Learned from Weapon-marking Initiatives," Number 28 April 2013. https://www.sipri.org/sites/default/files/research/disarmament/dualuse/pdf-archive-att/pdfs/small-arms-survey-lessons-learned-from-weapon-marking-initiatives-english.pdf
8. Heinemann-Gruder, Bonn International Centre for Conversion, Assessment of The HALO Trust Marking and Registration of SALW Project in Bosnia-Herzegovina, 2019, p 22.
9. MOSAIC 06.10, UNODA, 2017, p 9.
10. UN General Assembly A/CONF.192/15, International Tracing Instrument, IV Record-keeping, Paragraphs 11–13.
11. Feasibility Study on Linking Small Arms & Light Weapons Registration Systems in South East Europe, SEESAC, 2016, p 38.

Improving Security in the DRC Through Weapons and Ammunition Management by Seiwoh, Fabry, de Nantes, and Pineda [from page 31]

1. As documented by the GoE, assisting the United Nations Security Council (UNSC) Sanctions Committee pursuant to resolution 1533 (2004) concerning the DRC, 2014, https://www.undocs.org/S/RES/1533(2004) [accessed 10 June 2020]. See e.g. UN GoE reports: S/2018/ 1133 p. 4 para. 6 S/2018/531, pp. 32-34, paras. 182-191; S/2017/1091, p. 19, para. 98; S/2016/466, p. 45, para. 229; S/2015/797, p. 12, para. 46; S/2015/19, p. 33, para. 154; S/2014/42, pp. 30-31, paras. 128 and 132; S/2012/843, p. 36, paras. 139-140; S/2011/738, pp. 141-142, paras. 563-565; S/2009/603, pp. 9-11, paras. 23-29; pp. 13-14, paras. 40–43.
2. "An Assessment of Illicit Small Arms and Light Weapons Proliferation and Fragility Situations, the Democratic Republic of Congo." The Regional Centre on Small Arms in the Great Lakes Region, 2018, https://recsasec.org/wp-content/uploads/2018/08/DRC-FRAGILITY-pdf.pdf [accessed 10 June, 2020]
3. The African Development Bank defines fragility as the "low capacity and poor state performance with respect to security and development." African Development Bank, 2014. "Africa Development Bank Group strategy for addressing Fragility and building resilience in Africa." Abidjan: Africa Development Bank.
4. X Zeebroek, W Paes, G Berghezan, and L Guesnet. "Etude Sur La Prolifération Des Armes Légères En République Démocratique Du Congo". Brussels GRIP, and BICC, 2010.
5. Karp, Aaron, 'Civilian Firearms Holdings, 2017.' Estimating Global Civilian-Held Firearms Numbers. Geneva: Small Arms Survey, the Graduate Institute of International and Development Studies, Geneva, 2018, http://www.smallarmssurvey.org/fileadmin/docs/T-Briefing-Papers/SAS-BP-Civilian-Firearms-Numbers.pdf [accessed 06 June, 2020]. Also see "Civilian Firearms Holdings, 2017," Small Arms Survey, https://bit.ly/3dkKc6m.
6. Internally displaced persons (IDPs) are sometimes placed temporarily in host communities (instead of IDP camps) where they reside with extended family or friends; however, host communities are not always relatives of the IDPs.
7. Central African Convention for the Control of SALW, their Ammunition, Parts and Components that can be used for their Manufacture, Repair or Assembly, also known as the Kinshasa Convention, aims at regulating SALW and combating their illicit trade and trafficking in Central Africa, 2010, http://disarmament.un.org/treaties/t/kinshasa/text [accessed 10 June 2020].
8. Nairobi Protocol for the Prevention, Control and Reduction of SALW in the Great Lakes Region and the Horn of Africa, 2004. The Protocol requires certain national legislative measures, the strengthening of operational capacity and sufficient measures to control SALW both state-owned and in civilian possession. Other provisions cover tracing, safe disposal, transfer of SALW and brokering, https://www.sipri.org/sites/default/files/research/disarmament/dualuse/pdf-archive-att/pdfs/recsa-nairobi-protocol-for-the-prevention-control-and-reduction-of-small-arms-and-light-weapons-in-the-great-lakes-region-and-the-horn-of-africa.pdf [accessed 10 June, 2020].
9. United Nations Programme of Action to Prevent, Combat and Eradicate the Illicit Trade in SALW PoA is a globally agreed framework for activities to counter the illicit trade in small arms and light weapons and control the negative consequences of Small Arms and Light Weapons. It was adopted by all UN member states in 2001, https://undocs.org/en/A/CONF.192/15(SUPP) [accessed 10 June 2020].
10. Arms Trade Treaty, regulating the international trade in conventional arms – from small arms to battle tanks, combat aircraft and warships–entered into force, 2014, https://unoda-web.s3-accelerate.amazonaws.com/wp-content/uploads/2013/06/English7.pdf [accessed 10 June 2020].
11. As mandated by Security Council Resolutions 2098 (2013), and subsequently 2409 (2018), 2463 (2019), and 2502 (2019).
12. Impact Evaluation Report, SA/LW project, UNMAS DRC, Katrin Stauffer, external M&E specialist provided by the Swiss Armed Forces, 2019
13. Data collected by UNMAS as of November 2020.
14. United Nations Institute for Disarmament Research, ''The Democratic Republic of the Congo Takes Action Towards a National Framework on Weapon and Ammunition Management'', 2016, https://reliefweb.int/report/democratic-republic-congo/drc-takes-action-towards-better-weapons-and-ammunition-management [accessed 10 June 2020].
15. United Nations Mine Action Service, DRC SA/LW project impact evaluation report, 2019. Also see United Nations Mine Action Service, DRC SA/LW post-project activity implementation case study conducted in Bukavu, 2020.
16. SDG 1 End poverty and all its Forms everywhere and SDG 16: Promote just, peaceful and inclusive communities.
17. The CNC ALPC, FARDC/PNC, and UNMAS collectively undertake joint assessments of FARDC/PNC facilities and personnel to determine if additional WAM training and infrastructure needs (safes, containers, etc.) are necessary.

Landmines in America's Backyard by Rutherford [from page 35]

1. "Command-detonated" and "victim-activated" landmines are modern terms not used during the Civil War.
2. In the 19th century, the term "torpedo" was used to define a type of explosive device that was deployed covertly, either on or just under the soil, or fixed to a river bank or bottom hidden by the water from unsuspecting ships. In today's terms, these torpedoes are now referred to as landmines, sea mines, IEDs, or booby

traps. In this article, I use the terms "torpedoes" and "landmines" interchangeably when referring to an explosive device designed to be placed under, on, or near the ground and to be exploded by the presence, proximity, or contact of a person and that will incapacitate, injure, or kill one or more persons.

3. Jack Kelly, *Gunpowder: Alchemy, Bombards and Pyrotechnics: The History of the Explosive that Changed the World* (New York, NY, 2004), 202.
4. These landmines are also referred to in the literature as self-detonating devices. S. W. Gross, "On Torpedo Wounds," The American Journal of the Medical Sciences, Isaac Hays, MD, ed., vol. 51 (April 1868), 370.
5. To a lesser extent, Confederate landmines also employed the Girardey percussion fuse, which was fabricated for the contact detonation of artillery shells. The fuse worked by placing a "serrated piece of a common artillery primer in the front of the fuze so that upon contact, the reaction was identical to that of the friction primer . . . anyone stepping on it detonated the shell." Examples have been recovered in South Carolina. See Charles H. Jones, Artillery Fuses of the Civil War (Alexandria, VA, 2001), 129.
6. Although landmines were inexpensive to create, there was a certain complexity about them that had to be mastered for them to be fully (and reliably) useful.
7. Using POWs to clear landmines is violation under modern international law today, but some of the other Federal responses to Confederate landmines, including targeting civilians for retribution and burning their homes, would also have been prohibited under today's international law. Moreover, the Federals also used marksmen as another counter-landmine measure to "clear a torpedo by shooting the fuse and exploding it." Schneck, "Foreword," in Michael P. Kochan and John C. Wideman, Civil War Torpedoes: A History of Improvised Explosive Devices in the War Between the States, 2nd ed. (Paoli, PA, 2011), xiv–xv.
8. William T. Sherman, *Sherman's Civil War: Selected Correspondence of William T. Sherman, 1860–1865*, Jean V. Berlin and Brooks D. Simpson, eds. (Chapel Hill, NC, 1999), 731.
9. President Jefferson Davis to Col. William M. Browne, Aide-de-Camp, Augusta, Georgia, November 22, 1864, United States War Department. *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, Volume 44, 880–881. Washington, DC: U.S. Government Printing Office, 1880–1901.
10. G. T. Beauregard to Maj. Gen. S. Jones, December 6, 1864, United States War Department. *The War of the Rebellion: A Compilation of the Official Records of the Union and Confederate Armies*, Volume 44, 934. Washington, DC: U.S. Government Printing Office, 1880–1901.
11. William Tecumseh Sherman, *The Memoirs of General W. T. Sherman by Himself* (Bloomington, IN, 1957), 194.
12. Fired artillery shells did not always detonate for a wide variety of reasons. "Field recoveries," in North South Trader's Civil War, vol. 35, no. 6, 17. Jack W. Melton, Jr., "Accurate Projectile Names," in North South Trader's Civil War, vol. 35, no. 6, 56.
13. Jack W. Melton, Jr., "Accurate Projectile Names," in North South Trader's Civil War, vol. 35, no. 6, 56.
14. Notable exceptions include landmine use in Jackson, Mississippi; Williamsburg and Yorktown, Virginia; and on the roads around Goldsboro and Kinston, North Carolina.
15. John R. Weaver II, *A Legacy in Brick and Stone: American Coastal Defense Forts of the Third System, 1816–1867* (McLean, VA, 2001), 33.
16. Robert Knox Sneden, *Eye of the Storm: A Civil War Odyssey*, Chares F. Bryan Jr. and Nelson D. Lankford, eds. (New York, NY, 2000), 283. More recently, in 2008, a relic restorer in Chester, Virginia, was killed in his driveway working on a live artillery round.
17. Chester G. Hearn, *Mobile Bay and the Mobile Campaign: The Last Great Battles of the Civil War.* (Jefferson, NC: McFarland & Company, 1998). 200; Nineteenth-century newspaper headlines in the Mobile area regarding the finding of unexploded ordnance and landmines, included "Old Shells Unearthed Here at Civil War Battery Site," "Civil War Munitions Dump Found in Mobile," and "Old Shell Found in Yard."
18. According to the leading publication for Civil War relic hunters, "There have been scant few other explosions and injuries, most recently the July 2006 incident that injured Lawrence Christopher of Dalton, Georgia." Stephen W. Sylvia, "Publisher's Forum: Look Out for Baseballs," in North South Trader's Civil War, vol. 33, no. 2, 7.
19. United States Department of State Bureau of Political-Military Affairs, Hidden Killers: The Global Landmine Crisis (Washington, DC, 1994). This was the first report to estimate the magnitude of the landmine threat in terms of numbers of mines laid and numbers of mine-related deaths and injuries.
20. At Battery Wagner, Union engineers breached the Confederate minefields by digging trenches and saps toward the fortifications.
21. "Landmine Monitor 2019," *The Landmine Monitor*, May 2019, https://bit.ly/3bdlMKR, accessed 31 August 2020.

Table 1

i. Although inadvertent and unnoticed by Union forces at the time, artillery fire proved the undoing of the minefields at Fort Fisher when it severed electric lines or destroyed the torpedoes.
ii. Fort McDermott is considered an extended fortification of Spanish Fort's defenses, where Confederates had also deployed nuisance mines. Specifically, they were located at a watering hole distant from the fort's immediate defensives. To avoid double counting, the deployment of these nuisance landmines are placed in the column for Spanish Fort rather than Fort McDermott.
iii. While General Sherman wrote that he believed the landmines that took the leg of one of his officers during their "March to the Sea" were "nuisance landmines," they are not listed as such in this chart, as most likely the Southern defenders used them as a delaying weapon so that they could recalibrate their own defensive strategy and gain additional time.
iv. Port Hudson is the only known American Civil War location where command-detonated and victim-activated landmines were used simultaneously. It is also the first time in the world's history, as far as the author knows, that both command and victim activated landmines were used in the same location.

Strengthening a Sustainable National Capacity for Gender and Diversity Mainstreaming in Mine Action by Biscaglia, Sophal, Sochenda, and Sabeeh [from page 39]

1. "Goal 16: Promote just, peaceful and inclusive societies." Sustainable Development Goals, United Nations. Accessed 18 September 2020. https://bit.ly/2Ec9wy6
2. "Supporting Capacity Development: The UNDP Approach." United Nations Development Programme Bureau for Development Policy. n.d.
3. "Goal 10: Reduced inequality within and among countries." Sustainable Development Goals, United Nations. Accessed 18 September 2020. https://bit.ly/3myp4h8
4. Bourke, Julie and Andrea Espedido. "The Key to Inclusive Leadership." *Harvard Business Review*, 6 March 2020. Accessed 18 September 2020. https://bit.ly/3hQdvhS
5. Notably, the CMAA, with the support of the CFR-Project/UNDP, is contracting a national consultant to address these challenges.
6. As of July 2019, the ToR is pending approval by the CMAA Secretary-General.
7. "Oslo Action Plan Draft." 4th Review Conference Mine Free World, Oslo, Norway, 25-29 November 2019. Accessed 18 September 2020. https://bit.ly/2RCWFYO

Assessing Ukraine's Victim Assistance Capacities by Mashchenko, Shymanchuk, Stoiev, and Vovk [from page 43]

1. Government of Ukraine, Request for an Extension of the Deadline for Completing the Destruction of Anti-Personnel Mines in Accordance with Article 5 of the Convention: Executive Summary [sic], (Geneva: AP Mine Ban Convention Implementation Support Unit, 2020), https://bit.ly/3izQn8A.
2. International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC), *Landmine and Cluster Munition Monitor 2019: Twenty Year Review*, Geneva: ICBL-CMC, 2019, https://bit.ly/2CspuDx.
3. Referring to the terminology of IMAS 13.10 and to avoid ambiguity with legal jargon, the article uses 'EO victims' as an expression for both injured survivors and those killed by EO accidents.
4. United Nations Mine Action Service (UNMAS), IMAS 13.10 Victim Assistance (First Edition), New York: UNMAS, 2020, https://bit.ly/32iFsKO.
5. Danish Refugee Council-Danish Demining Group (DRC-DDG), Assessment Report: Mine Victim Assistance Needs, Ukraine: DRC-DDG, 2018, https://bit.ly/3foXXRB.
6. Due to the absence of a nationally held EO casualty database, DRC-DDG has been compiling this information via open source data; it is, therefore, not a conclusive dataset. Available at: https://bit.ly/2Zj2Y8D.
7. Organization for Security and Co-operation in Europe, Special Monitoring Mission to Ukraine (OSCE: SMM), Thematic Report: The Impact of Mines, Unexploded Ordnance and Other Explosive Objects on Civilians in the Donetsk and Luhansk Regions of Eastern Ukraine, Ukraine: OSCE SMM, 2019, https://bit.ly/3jiYHKk.
8. United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), Humanitarian Needs Overview: Ukraine, Ukraine: UN OCHA, 2020, https://bit.ly/2CfVV8g.
9. Organization for Security and Co-operation in Europe, Special Monitoring Mission to Ukraine (OSCE: SMM), Thematic Report: The Impact of the Conflict on Educational Facilities and Children's Access to Education in Eastern Ukraine, Ukraine: OSCE SMM, 2020. https://bit.ly/2GLAz4f.
10. National VA-related regulations include: Constitution of Ukraine (article 27 – right to life; article 46 – right to social protection; article 49 – right to healthcare; and article 50 – right to safe environment) and other laws related to social protection depending on the context (law no. 875 – basics of social protection of individuals with disabilities; law no. 2402 – on protection of childhood; law no. 1706 – on ensuring rights and freedoms of internally displaced persons (IDPs), etc.). Ukraine signed certain applicable international treaties (e.g. *Convention on the Prohibition of the Use, Stockpiling, Production, and Transfer of Anti-Personnel Mine and on Their Destruction, Convention on the Rights of Persons with Disabilities, Convention on the Rights of the Child and its Optional Protocol*, etc.) and plans to ratify more in the near future (i.e. European Convention on the Compensation of Victims of Violent Crimes).
11. The amendment is designed to address some of the concerns outlined in this article. However, at this moment it is impossible to predict the scope and the effect of its implementation, as they rely on the Cabinet's development of the related by-laws, budget allocations, and the quality of their enforcement by the local authorities and other actors. Therefore, this article is written based on the still valid edition of MAL, adopted on 6 December 2018, and amended on 25 April 2019.
12. United Nations, The United Nations Policy on Victim Assistance in Mine Action. 2016 Update, n.p.: United Nations, 2016, https://bit.ly/2WjAh9W.
13. Kasack, Sebastian, "Assistance to Victims of Landmines and Explosive Remnants of War: Guidance on Child-focused Victim Assistance," New York: UNICEF, 2014, https://bit.ly/3exTNpj.
14. United Nations Mine Action Service (UNMAS), "IMAS 13.10 Victim Assistance: First Edition," New York: UNMAS, 2020, https://bit.ly/3ehUcO3.
15. The Likert scale is a five (or seven) point scale that is used to allow the individual to express how much they agree or disagree with a particular statement.
16. The term "snowball sampling" refers to a recruitment method in which participants assist researchers in identifying additional potential subjects.
17. At the national level, DRC-DDG conducted interviews with ministries of Reintegration of Temporarily Occupied Territories of Ukraine, Social Policy, Health, and Education; State Service for War Veterans' Affairs; Commissioner for Observance of the Human Rights of the Verkhovna Rada; State Emergency Services of Ukraine (SES); and two national experts on child protection. In Luhansk and Donetsk re-

gions, interviews were held with Child Affairs Services; Center for Social Services for Families, Children, and Youth; national and juvenile police; regional SES and departments of education, health, social and civil protection. Interviews were also conducted with local social protection units, administration representatives, Child Affairs Service, Inclusive Resource Center, rehabilitation center for children with disabilities, four (children's) hospitals, four village councils, and three schools. Other interviewed stakeholders included (inter)national NGOs and international entities (ICRC, Education Cluster, WHO, and the OSCE).

18. The term "purposive sampling" is an intentional selection of informants based on their ability to elucidate a specific theme, concept, or phenomenon.
19. For the sake of accuracy, the initial draft law was titled Law 9080/01 of 6 December 2018. The final adopted version was Law 2642-VIII. The only amendment adopted so far was No. 2706-VIII of 25 April 2019. DRC-DDG is currently advocating for the adoption of draft amendment No. 2618.
20. Underage victims are additionally entitled to a one-time monetary compensation; annual healthcare assistance; free medical and psychological rehabilitation in specialized centers and compensation of travel costs; and a monthly disability assistance (until full age).
21. Chernysh Vadym, Interview with Chernysh Vadym, Minister of the Ministry for Reintegration of Temporary Occupied Territories of Ukraine, Chernysh Vadym: Population Warning About Mine Contaminated Areas and Assistance for Affected Persons – What is Needed and Can be Done Right Now, First National TV Channel, 13 June 2019, https://bit.ly/2ZnSo0a.
22. Constitution of Ukraine, article 19, https://bit.ly/2Wlepel.
23. Fiederlein, Suzanne and SaraJane Rzegocki, "The Human and Financial Costs of the Explosive Remnants of War in Afghanistan, Costs of War," Watson Institute for International and Public Affairs, Brown University, 2019, https://bit.ly/3ilfRpP.
24. Center for International Stabilization and Recovery, "Landmine Casualty Data: Best Practices Guidebook," Global CWD Repository, 12, 2008, https://bit.ly/33keLo7.
25. Durham, Jo, Peter S. Hill, and Damian Hoy, "The Underreporting of Landmine and Explosive Remnants of War Injuries in Cambodia, the Lao People's Democratic Republic and Viet Nam," *Bulletin of the World Health Organization* 91, 2013: 234-6, https://bit.ly/33cfWG2.
26. World Health Organization (WHO), "ICD-11 for Mortality and Morbidity Statistics," WHO, version 04, 2019, https://bit.ly/2OsUwgY.
27. REACH, Protection Assessment of Isolated Settlements in Government-Controlled Areas Along the Contact Line, Ukraine: REACH, 2019, https://bit.ly/3kf8NMe.
28. It is noteworthy that DRC-DDG, together with partners from the Working Group on MAL of the MA Sub-Cluster in Ukraine, have recently succeeded to incorporate a provision on compensation of housing costs for EO victims during the rehabilitation. As for the provision of EO victim status and VA data collection, they are anticipated to be fixed at the level of by-laws once the amendment is adopted.
29. Ferguson, Angela D., Beth Sperber Richie, and Maria J. Gomez, "Psychological Factors After Traumatic Amputation in Landmine Survivors: The Bridge between Physical Healing and Full Recovery," *Disability and Rehabilitation* 26 (2004): 14-5, 931-8, https://bit.ly/3bV7AGY.

Explosive Ordnance Victims and Risk Education: Lessons Learned from Colombia 2012–2019 by Valencia, De Santis, Wilson, Jaramillo, Sánchez, Alfonso [from page 49]

1. OACP is a dependency of the Administrative Department of the Presidency of the Republic of Colombia. Within its structure is the Action Against Antipersonnel Mines - AICMA working group. The aim is to assist the National Government in the design, formulation, and coordination of plans, programs, and activities related to mine action (humanitarian demining, education on the risk of antipersonnel mines, and comprehensive assistance to victims).
2. Oficina del Alto Comisionado para la Paz. Descontanima Colombia. http://www.accioncontraminas.gov.co/Paginas/aicma.aspx.
3. International Campaign to Ban Landmines – Cluster Munition Coalition (ICBL-CMC). *Landmine Monitor 2020.* 22nd ed. http://www.the-monitor.org/media/3168934/LM2020.pdf.
4. Geneva International Center for Humanitarian Demining. GICHD - Risk Education. cited 2020 Apr 28. Available from: https://www.gichd.org/en/our-response/risk-education/.
5. "Imas Mine Risk Education Best Practice Guidebook 1. An Introduction To Mine Risk Education." Geneva, 2005.
6. There is evidence of EORE activities before 2010. Work was carried out in the affected communities through mobile classrooms, where EORE training and basic life support were given. Through agreements with the coordinating entity of National Parks (NP)of Colombia, workshops were held for NP staff and the population surrounding the parks; talking maps to collect information on the impacts to the community; design of prevention cards for NP staff; and the inclusion of prevention messages within their risk action plans. Training was also carried out for municipal civil servant and other territorial entities. In addition, the EORE standard was prepared, as well as the guidelines for the construction of EORE materials. This work was done in coordination with UNICEF and other EORE partners. Likewise, before 2010 the National EORE technical tables were held. In 1996, the strategy "We all have the right to have our feet on the Earth" was launched by UNICEF, the International Committee of the Red Cross, the Colombian Campaign against Antipersonnel Mines, among other partners.
7. Rapid response EORE is a strategy to assist early alerts, which was designed by the Ombudsman's Office of Colombia to identify and evaluate risk situations for the civilian population resulting from the armed conflict (among which are the presence of EO) and informs the OACP.
8. Oficina del Alto Comisionado para la Paz. Descontamina Colombia. [cited 2020 May 8]. http://www.accioncontraminas.gov.co/Paginas/aicma.aspx.
9. Oficina del Alto Comisionado para la Paz. Descontanima Colombia [Internet]. http://www.accioncontraminas.gov.co/Paginas/aicma.aspx.
10. Military activities.
11. J Durham, S Gillieatt, B Sisavath. "Effective Mine Risk Education in War-Zone Areas--A Shared Responsibility." *Health Promot Int.* 2005;20(3):213-220. doi:10.1093/heapro/dai014
12. Manual eradication is a program that was implemented due to the critical increase of illicit crops in areas of peasant economy, areas belonging to the national system of natural parks and / or close to water bodies, streams and human settlements. It consists of the elimination of illicit crops in an artisanal way, through the physical force of a person. The plants are held and pulled, producing the detachment of their roots. https://www.mindefensa.gov.co/irj/go/km/docs/Mindefensa/Documentos/descargas/Documentos_Descargables/espanol/Erradicacion%20manual%20de%20coca.pdf.
13. Campaña Colombiana Contra Minas. Educación en el Riesgo De Minas, Una Estrategia Que Salva Vidas [Internet]. 2015 [cited 2020 Feb 15]. Available from: https://colombiasinminas.org/accion-contra-minas/educacion-en-el-riesgo-de-minas/educacion-en-el-riesgo-de-minas-una-estrategia-que-salva-vidas/.
14. Durham, Jo & Gillieatt, Sue & Sisavath, Bounpheng. (2005). "Effective mine risk education in war-zone areas - A shared responsibility." Health promotion international. 20. 213-20. 10.1093/heapro/dai014.

Proof: How Small Drones Can Find Buried Landmines in the Desert using Airborne IR Thermography by Fardoulis, Depreytere, Gallien, Djouhri, Abdourhmane, and Sauvage [from page 55]

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The Journal invites government/nongovernment organizations, field/research practitioners, policy advisors, and technical experts working in humanitarian mine action/conventional weapons destruction to contribute their challenges, experiences, and lessons learned in the form of practice-based article submissions.

Men wait to be fitted for new prosthetics in Vietnam.
Photo courtesy of CISR.

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CALL FOR PAPERS

COVID-19 and HMA

Already struggling with nonexistent or insufficient essential services and infrastructure, post-conflict environments are at risk of facing even greater challenges compounded by COVID-19. Months into the pandemic, how have HMA organizations responded to the pandemic and in what ways have they adapted their operations both in and out of the field?

Battle Area Clearance/Urban Clearance

In areas known to be free of landmines, how are organizations mitigating the challenges of battle area and urban environments to remove explosive remnants of war and other munitions from hazardous areas while ensuring the safety and security of their clearance teams? What lessons learned can organzations share in regards to surface/subsurface search, marking, and disposal techniques; rapid response, training, and operational support capacities; and security, site management, and rubble removal concerns?

Prosthetics

Specialist organizations and individuals working with prosthetics in HMA are encouraged to submit articles on the use of prosthetics for landmine and UXO survivors. Topics may include the latest technological advances, prosthetics within the context of mine action legislation, effects of decreased funding for victim assistance, and integration of disability support services in HMA.

Mobile and/or Efficient Data Collection Methods

Collecting data via handheld devices such as mobile phones and tablets has become the industry standard. How are organizations ensuring data collection forms actually improve the efficiency and efficacy of personnel to record and manage data?

Ukraine

Contamination in Ukraine continues to affect populated areas, infrastructure, civilians crossing contact lines at checkpoints, and IDPs and returning refugees. *The Journal* seeks submissions from organizations conducting survey, clearance, risk education, victim assistance, and battle area clearance.

Environmental and Weather Challenges of HMA/CWD

As different regions of the world experience diverse environmental and weather hazards ranging from extreme temperatures; extensive rainfall, flooding, and ensuing mudslides; sandstorms; snowstorms; and areas with dense vegetation (jungles and forests), barren landscapes (deserts), and steep terrain (mountainous regions), what conditions are HMA organizations facing? How are organizations specializing their operations to adapt to such nuanced environmental factors while working in areas confirmed or suspected of being contaminated? What policy-related actions should be considered now for future work in the HMA sector to maximize sustainable programs and limit their impacts on the environment? What should HMA operations consider and what role can donors play in ensuring environment-/climate-related issues are addressed in future work?

Commercial Off-the-Shelf Tools for Mine Action

Commercial off-the-shelf (COTS) products requiring minimum adaption for HMA save on development costs while providing practitioners with a steady supply of new technologies. What COTS products or systems are your organizations repurposing, and how have these improvised uses enhanced your work?

Research and Development

The Journal seeks research and development (R&D) articles. All technical articles on current equipment, technology, trends, and developments in the field of mine action and CWD will be considered. Commercial companies, NGO's, and researchers are encouraged to submit. R&D articles are submitted to three experts for anonymous peer review and two of the three reviewers must approve the article for publication. Reviewers approve articles for publication, suggest revisions, or reject articles for publication.