UKRAINE

INTERVIEWS WITH HMA DIRECTORS

THE ENDLESS WAR
PHOTO ESSAY BY ROCCO RORANDELLI
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 it reserves the right to edit accepted articles for readability and space, and 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.

Please note that all rights to content, including photographs, published in The Journal are reserved. Notification and written approval are required before another source or publication may use the content. For more details please visit our website or contact the managing editor.

This publication is funded [in part] by grants from the United States Department of State. The opinions, findings and conclusions stated herein are those of the author[s] and do not necessarily reflect those of the United States Department of State, the United States Department of Defense, James Madison University, or the Center for International Stabilization and Recovery.

Please direct all submissions and questions to:
Jennifer Risser, Managing Editor
CISR/James Madison University-MSC 4902
Harrisonburg, VA 22807
Email: cisr-journal@jmu.edu
Website: http://www.jmu.edu/cisr

To help save natural resources and protect our environment, this edition of The Journal of Conventional Weapons Destruction was printed on 30-percent post-consumer waste recycled paper using vegetable-based inks.
TABLE OF CONTENTS

INTERVIEWS WITH HMA DIRECTORS

The Journal of Conventional Weapons Destruction is introducing a section dedicated to sharing the insights and experiences of the field. This issue features HMA directors. Future issues will feature interviews with photojournalists, survivors, and veterans of the HMA community, among others. The views expressed in the interviews are those of the interviewee(s) and do not necessarily reflect the views of The Journal or its sponsors. If readers would like to suggest specific ideas for interviews, please contact the publications staff at cisr-journal@jmu.edu.

4 MAJOR GENERAL J.M. COWAN, The HALO Trust
6 ARIANNA CALZA BINI, Gender and Mine Action Programme
8 AMBASSADOR STEFANO TOSCANO, Geneva International Centre for Humanitarian Demining
10 ALLAN VOSBURGH, Golden West Humanitarian Foundation
12 DR. JANE COCKING, MAG (Mines Advisory Group)

UKRAINE

13 Ukraine’s Newly Adopted Mine Action Law: What Does This Mean for MA Programs? by Henrique Garbino [Swiss Foundation for Mine Action]
17 The Challenges of Humanitarian Mine Clearance in Ukraine by Toby Robinson and Rosanna O’Keeffe [The HALO Trust]
24 Contamination in Eastern Ukraine: Observations by OSCE SMM by Edward Crowther [OSCE]

SOUTHEAST EUROPE

27 MINELAND THE ENDLESS WAR A PHOTO ESSAY BY ROCCO RORANDELLI
37 ITF ENHANCING HUMAN SECURITY IN SERBIA BY GREGOR SANČANIN [ITF ENHANCING HUMAN SECURITY]

Lessons from the Past

40 Minefield Clearance and Casualties – Holland 1945 – Military Operational Research Unit Report No.7 by Roly Evans [GICHD]

FIELD NOTES

47 Accidents and Field Medical Provision by Andy Smith [University of Genoa]
52 Booby-traps and Anti-handling Devices: COMMON TACTICS by Michael Cardash [Terrogence]
58 Collaborative Demining Training in Cambodia by Jorge Rivero [U.S. Marines] and Tom Gersbeck [Oklahoma State University]

RESEARCH AND DEVELOPMENT

62 Drones in the Desert: Augmenting HMA and Socio-Economic Activities in Chad by John Fardoulis [Mobility Robotics], Xavier Depreytere, Emmanuel Sauvage, and Pierre Gallien [Humanity & Inclusion (HI)]

ENDNOTES

On the cover: A sign marks a minefield in Ukraine. Photo courtesy of The HALO Trust.
James Cowan is CEO of The HALO Trust (HALO), a leading NGO clearing the debris of war with over 8,500 staff in 24 countries. At a time of unprecedented, man-made humanitarian crises, HALO’s work has never been more important.

James was a soldier for 30 years, serving in Germany, Northern Ireland, Africa, Hong Kong, Iraq, and Afghanistan. He commanded his regiment, The Black Watch, in Iraq in 2004 during fighting in Basra and subsequently around Fallujah. He was back in Iraq in 2006–2007, again in Basra. He took command of Task Force Helmand and served in Afghanistan during 2009–2010. He was subsequently Head of Counter Terrorism in the British Ministry of Defence and led the planning for the 2012 Olympics military security operation. His last job in the British Army was as General Officer Commanding the 3rd (U.K.) Division.

James left the British Army in 2015 to become CEO of HALO. He read modern history at Oxford and took a Masters of Philosophy at Cambridge and has a long-standing interest in military history and the Napoleonic Wars. He is married to Minnie with three children and lives in Dorset, United Kingdom.

1. In your opinion, what are the main challenges facing the conventional weapons destruction (CWD) and humanitarian mine action (HMA) community today (funding, strategic planning, governance, development approaches, staffing, political interference, networking of organizations within uncertain political and external environments, etc.); how are they typically overcome?

As we enter our third decade of work, the mine action sector faces two challenges: first, we need to fulfil the promise to the millions of forgotten people who continue to live in fear from explosive remnants of war (ERW). Secondly, we must adapt to the current and future humanitarian requirements caused by war; far more people are being harmed by this second category.

Legacy contamination. Landmines remain as dangerous as ever to the 60 million people affected by them worldwide, restricting access to land, livelihoods, and endangering the lives of those who live nearby. Despite this continued danger, funding of legacy mine action programs remains a challenge. We must respect competing humanitarian priorities, without allowing donor fatigue, or diminishing foreign aid budgets to damage our work.

The Landmine Free 2025 (http://landminefree2025.org) campaign seeks to change this narrative and reinvigorate support to achieve completion in as many places as possible by 2025. Completion is possible and achievable with the right financial and political commitment from both donor and affected states, but will take innovative thinking and agility to achieve. As such, we are exploring innovative solutions that have been developed in other sectors, such as alternative funding mechanisms and social financing that may provide additional support to mine action.

Improvised explosive devices (IED). In addition to legacy mine problems, the mine action sector is also confronting new contamination in many regions. IEDs are not new, and in the majority of cases, they fall under the globally agreed definition of landmines. However, the new use of these weapons and massive scale of IED contamination in the Middle East and other regions, leading to a considerable increase in casualties, give reason to develop new techniques, training, and methods to meet the evolving nature of modern landmines.

Urban clearance. Linked to the proliferation of improvised mines and the changing nature of warfare is the requirement for large-scale, urban rubble clearance and reconstruction. The physical challenge of destroyed buildings, reinforced concrete, and booby-trapping create significant technical challenges on a daunting scale for mine clearance operators.

HALO has begun to adapt to meet these challenges by developing new survey techniques for urban areas. We are adapting machines used for urban clearance in Afghanistan and other contexts, and developing pilot projects in Afghanistan to trial new techniques for clearance.

Neutral humanitarian space. The wars of the 21st century are more likely to take place in urban populated areas, where the lines between peace and formal war, and between civilian and combatant are increasingly fluid. With numerous non-state actors in communities, negotiating access becomes an ongoing process rather than a precursor to engagement. HMA operators must be flexible and nimble to be able to adapt, and change areas of operation swiftly in line with changing conditions, while protecting the safety of staff and communities.

2. Transitioning from the British Army to an international non-governmental organization (NGO), how did your past work prepare you for The HALO Trust, what lessons learned have been the most valuable for you?

During my time as a soldier I fought in Northern Ireland, Iraq, and Afghanistan and served in many other places.
I began my service in Berlin, protecting it from the Soviets—the war that, thankfully, never was.

I’ve learnt several lessons from that experience:

- First, the British Army of 1989 was geared for a conventional fight against the Warsaw Pact. Now it has changed out of all recognition to deal with the much more complex threats of terrorism and cyber warfare, while still being able to protect the UK against a resurgent Russia. There are parallels with mine action, which still has a legacy threat to clear, but I don’t think the sector has dared to change at the same pace, and it needs to catch up.
- Second, the British Army teaches leadership—I see a sector afflicted by management speak. I’d like to see more leadership and a clearer sense of direction.
- And third, the British Army teaches Mission Command, by which it means trusting those who can be trusted. Mine action could usefully do the same.

3. During your career in the military, how do you feel explosive hazards clearance has evolved over the years?

War is, at its heart, an attempt to out-maneuver your enemy. To achieve this, you need to move without friction, breaching natural and man-made obstacles. Conversely, you must limit your enemy’s capacity to maneuver by creating obstacles. In the 1980s, clearing and laying landmines played a major part in this, but as war became more three-dimensional, the use of landmines became less relevant—helicopters, insurgents, and cyber warriors aren’t very worried by landmines. Now it is the IED that dominates and, along with the proliferation of small arms, the mine action sector needs to reinvent itself to counter these two threats.

4. Going forward, what opportunities do you see for HALO and other HMA NGOs, and how well-prepared do you think the wider HMA/CWD community is for the future?

We need to be better at forecasting and responding to the world of 2049, not 1989. In my view, growing populations, urbanization, competition for land, climate change, biodiversity, non-state conflict, and threats to the rules-based international order will predominate. Mine action is good at dealing with the world as it was in 1989 or in 1997 when the Ottawa Treaty was signed, but that is not a recipe for future success. We are in danger of entering our anecdotage, addicted to the good old days—it’s time to make space for younger, fresher thinking.

While only 10 percent of countries are currently on track to meet their completion deadlines, we are also presented with a great opportunity to increase the completion rate and make life better for 60 million people. With a bit of innovative thinking and increased political engagement from donors and affected countries mines could be eradicated.

As we approach completion of clearance in many countries around the world, the HMA community must be aware of the consequences of our exit. As humanitarian organizations, we bear responsibility for the impact of our presence or lack thereof on our staff and the communities where we work. We must therefore pay careful attention to how we draw down operations as we approach country completion or transfer over to national authorities. It also means there is an opportunity to do this correctly. This means exploring partnerships with other NGOs, which might be able to provide livelihood supports or training. It also means ensuring that there is sufficient national capacity to deal with any residual contamination, which may be discovered in the future.

The HMA community faces a challenge that every humanitarian sector wishes to face. Within the next decade, we expect that large-scale mine clearance operations will be reduced in many countries, in all but a handful of countries such as those in the Middle East.

The HMA community thus faces a dilemma and an opportunity. Should we pivot and expand the scope of our operations where we can bring value, or should we slowly reduce in size as we accomplish our goal of a landmine free world? To achieve your mission is the ultimate aim of every humanitarian organization. Nevertheless, to eclipse would do a disservice to significant and transferable skills of the HMA sector and deep knowledge of local needs and context. HALO’s mission is to “protect lives and restore livelihoods for those threatened by conflict.” While the nature of the threat may change as conflicts evolve, HALO’s mission will remain the same. We believe our sector has value to add in supporting countries post-conflict and therefore could successfully diversify into areas beyond our traditional mine action and conventional weapons work.

5. While working in HMA, what experience, lesson, or event has impacted you in your role as CEO the most? (This could be a travel experience, people met/worked with, challenge, etc.)

Last year, HALO suffered a mine accident in Nagorno-Karabakh that killed three, badly wounded one, and harmed a fifth person. It reminded me of the extraordinary commitment that people in HALO and mine action more broadly make to this wonderful humanitarian cause. We could not do our work without them and I salute the sacrifice and endeavor of the amazing men and women who, day after day, go out to make the world a safer place.
1. In your opinion, what are the opportunities and challenges to ensure that conventional weapons destruction (CWD) and humanitarian mine action (HMA) are gender and diversity-responsive (funding, strategic planning, governance, development approaches, staffing, political interference, networking of organizations within uncertain political and external environments, etc.) and how can the international community address these?

In the ten years I have been involved in CWD and HMA, I think the main challenges for gender and diversity to be taken seriously have been:

- the lack of understanding of gender and diversity and their relevance in the mine action context.
- the lack of political will and commitment of management to mainstream gender and diversity in programs and projects.
- the limited capacity to mainstream gender and diversity in certain contexts.
- funding restrictions (for example, donor procedures not allowing to pay for staff on maternity leave) and lack of gender budgeting.

Since I started working with the GMAP in 2009, I have also seen progress in all these areas, and there is increasing recognition in the sector of the importance of mainstreaming gender and diversity in order to deliver more inclusive, effective, and efficient activities.

It has become clear that one size does not fit all, and that gender and diversity need to be considered in all aspects of mine action, from strategic planning to recruitment policies and practices, all the way to uniforms and personal protective equipment.

In my opinion there is currently tremendous momentum to ensure that gender and diversity are systematically taken into account in CWD and HMA, and to realize the sector’s potential to contribute to gender equality, inclusion, and the empowerment of women and girls.

The Women, Peace and Security agenda and the Sustainable Development Goals constitute an important international framework for gender-responsive mine action. Most operators have realized the importance of gender and diversity for their operations and have policies/strategies and good practices in place. While ensuring that interventions are gender and diversity sensitive—i.e., take into account the different needs, priorities, and capabilities of women, girls, boys, and men—is currently considered to be the very minimum, many operators are now also interested in the transformative impact that mine action can have in promoting more gender equality and empowerment of women.

Several donors support and even require mine action interventions to be at a minimum gender sensitive, while some go beyond and have feminist foreign and aid policy that require transformative actions. National mine action authorities are requesting support to develop their capacity on gender and diversity and adopt strategies and standards that reflect best practices.

The United Nations has a new mine action strategy with an even stronger focus on gender and will soon launch revised Gender Guidelines for Mine Action Programmes. The GICHD has adopted a new strategy in which one of the four strategic goals is “Gender equality and inclusion are achieved and women and girls are empowered.” GMAP was integrated into the GICHD in March this year to translate this commitment into tangible support and services for the CWD and HMA sector and to enable a multiplier effect by mainstreaming gender and diversity in all the knowledge generated and disseminated by the GICHD.
2. How has your prior professional experience prepared you for being Director of GMAP and what lessons learned have been the most valuable for you?

Growing up in an Italian-Swedish family, I always had interest and curiosity for other cultures, different ideas, and perspectives. I also never felt entirely part of just one culture, as even at home there would always be differing opinions and practices. As a girl and young woman growing up in Italy, I experienced street harassment, sexual harassment, and sexism, and always felt very uncomfortable and upset about it. It took me some time and studies to be able to articulate how very wrong those “normalized” behaviors were and to react to them.

Undoubtedly my upbringing influenced my study choices towards international economics and development. During my studies I was confronted with some of the deep inequalities and injustices of this world and the ones that came closer to my heart were the ones between the Global North and the Global South (for lack of a better definition), and those between men and women. I decided to pursue a career in international cooperation and development and ended up spending 10 years in the Latin American region working for the European Union and United Nations Development Programme with a strong focus on gender.

One of the first lessons I learned as a young professional and as a woman was how to be heard and valued by colleagues, supervisors, and counterparts. Working in multicultural environments, I always tried to listen and show respect for other people’s beliefs and opinions while promoting change. It was important to learn how to balance openness and flexibility with integrity, especially when promoting women’s rights and gender equality.

Other important and useful lessons were how to engage with diverse stakeholders towards a common goal, and how bureaucracy and control are necessary but can be too heavy, to the point they hinder the delivery of actual results.

Family reasons took me back to Europe and specifically to Switzerland where, after having a daughter, I decided to engage in the intersection between the humanitarian sector and the promotion of gender equality. The Gender and Mine Action Programme offered me the ideal opportunity to do this and what was supposed to be a maternity leave of a few months in 2009 ended up being a 10-year endeavor in the HMA sector.

3. As a strong, female leader involved in the NGO sector, what are the most significant barriers you have faced?

I feel very lucky and privileged as I have mostly been respected and valued in my professional career. It has not always been easy and smooth, but I have managed to develop respectful, collaborative, and productive relationships with colleagues, partners, and authorities throughout my life.

When I started with GMAP in 2009, coming from the broader development sector, I was new to HMA and it took me some time to really understand and familiarize myself with all areas and technicalities of the sector, and to earn credibility. I was confronted with a relatively small community that was highly technical, male-dominated with a high proportion of military or former military people, where everybody seemed to know each other and many would make it clear that what counted for them was the technical, specialized knowledge and the ones holding it (themselves).

Working on what is sometimes described as the “soft” side of mine action, which is actually the side that focuses on people, I noticed a quite remarkable difference between the way colleagues from civil society and advocacy organizations (the International Campaign to Ban Landmines and others) welcomed me, and the initial condescendence and in some cases reluctance of colleagues involved in the more operational and technical side of mine action (mostly men) to engage with GMAP and me personally. Gender was not really a topic most of the sector valued or was even interested in at the time.

The representation of women in the sector has increased in the last ten years, but not significantly. The fact that it still is highly male-dominated means that I often find myself in situations where I am one of the few women present, advocating for the need to ensure the participation and inclusion of women and other underrepresented groups in mine action programs and forums.

I also think that there still is a tendency to highlight women in mine action as exceptional, and while they might well be great, doing so reinforces the view that they are an exception, rather than fully belonging in the sector in their own right, with their strengths and weaknesses.

4. While working in HMA, what experience, lesson, or event has impacted you in your role as Director the most? (This could be a travel experience, people met/worked with, challenge, etc.)

The one thing that has affected me the most is travelling to mine-affected areas and meeting the people who suffer from landmines and ERW contamination in their communities, the women, girls, boys and men who are survivors and indirect victims of this awful and indiscriminate scourge. Seeing their resilience and strength has been truly inspiring. At the same time, realizing how vulnerable and helpless they can be in certain situations is a constant motivation to work towards improving victim assistance and reducing the risk from explosive ordnance in a gender and diversity inclusive and equal manner.
1. In your opinion, what are the main humanitarian mine action (HMA) and conventional weapons destruction (CWD) obstacles faced by organizations working in HMA, specifically the GICHD?

Strong national commitment, a solid implementation architecture coupled to efficient operations, and international solidarity remain the three key factors of successful mine action work at a national level. Experience shows that, once in place, these factors go a long way in ensuring the timely fulfillment of treaty obligations and the attainment of national completion targets. In some parts of the world, however, we are witnessing a changing working environment. Mine action actors are called upon to work closer to conflicts due to their prolonged nature and pressing humanitarian needs, including in relation to the return home of displaced persons. These conflicts represent complex operational contexts by virtue of their urban nature, the multiplicity of actors and risks, and the unprecedented large-scale use of improvised explosive devices (IED), which often function like mines. Mine action actors wishing to operate there face challenges pertaining to the necessary operational space and the technical complexity of improvised devices.

On the former issue, a reflection in the sector is on-going regarding the when and how to negotiate humanitarian access. Institutional mandates entrusted to regional or international organizations can sometimes offer entry points in that regard, as exemplified by the framework provided by the Organization for Security and Co-operation in Europe (OSCE) in Ukraine. On the latter, the current revision of the International Mine Action Standards (IMAS) is paramount and will provide much needed guidance on the search and disposal of IEDs in urban settings.

Turmoil and conflict have also affected the functioning of national mine action programs. In some instances, national capacities are yet to be built. This is a significant challenge, not least for the GICHD, which usually works with established national institutions. The mine action sector has been very innovative in supporting local partners in difficult circumstances, such as through remote training.

With respect to the need for a solid implementation architecture and efficient operations, let me emphasize the key role of international and national standards in accelerating treaty implementation. The IMAS play a decisive role in turning the obligations enshrined in the conventions into reality in the field—as proven again and again in the 20 years since their establishment. It will be important to continue to make sure that they remain in sync with operational realities in the field.

Finally, on international solidarity: the 2025 and 2030 aspirational goals agreed upon at Maputo (3rd Review Conference (RC) of the Anti-personnel Mine Ban Convention (APMBC)) in 2014 and Geneva (6th Meeting of States Parties of the Convention on Cluster Munitions (CCM)) in 2016, respectively, were important levers to renew the cooperation between affected States, donor States, and other stakeholders. Yet, international funding remains under strain, particularly with regard to so-called legacy contamination. The upcoming 4th RC of the APMBC (Oslo, November 2019) is a welcome opportunity to reaffirm once again our commitment to achieving mine-free status in all affected countries around the world within the next few years and to emphasize the essential enabling role mine action plays with respect to humanitarian action, peace and security, and sustainable development. Reaffirming that mine action is more than mine action and showcasing what that means concretely will help, I am convinced, to re-energize and broaden its support base.

You will agree that the three factors of success mentioned earlier are as much important to mine action as they are to ammunition management. During many years, much of our focus in ammunition management used to be on short-term interventions and physical improvements of ammunition storage sites. This approach can prevent a disaster but has been challenged by the observed lack of lasting change in the capacities of and commitment by national partners. In response, international partners have started to adopt a comprehensive and gradual approach to institutional, legislative, and operational changes in ammunition management practices. In parallel, a strengthened application of the International Ammunition Technical Guidelines (IATG) is being pursued. Encouragingly, cooperation and funding for ammunition management have gone up significantly in recent times.

2. How have your roles as an ambassador and a diplomat prepared you for being Director of the GICHD, and what lessons learned have been the most valuable for you?

Well, I do not know that my diplomatic career so far was necessarily meant to prepare me for my current position. But more seriously, it definitely strengthened my personal interest in all things humanitarian
and disarmament, including the correlation between the two, enhanced my savoir faire with respect to multilateral diplomacy, and showed me first hand, in the frame of the small arms/light weapons (SA/LW) process leading to the UN SA/LW Conference in 2001 that negotiated the Program of Action to Combat Illicit Trafficking in SA/LW, how multi-stakeholder approaches can make a real difference both at the normative and field levels. All this is fully relevant to my current position as Director of a Centre dedicated to mine action and ammunition management from a humanitarian perspective and at both multilateral and field levels.

As a diplomat, I often tried and worked based on the belief that the combination of innovative ideas, strong partnerships, and some money can go a surprisingly long way to address apparently intractable issues. That belief is also guiding me in my current position, as we at the GICHD work with our partners to promote the sector-wide development and application of innovative concepts, methods and tools, for example in the field of information management.

3. How do you feel the field of HMA has evolved since you became director?

The field of mine action has evolved significantly in recent years. First of all, the wide recognition and year-long application of the land-release approach has transformed the underpinning narrative in mine action into one aimed at a progressive, evidence-based reduction of risks. This represents a fundamental “cultural” change towards a risk-reduction approach, a change that is fully reflected in the new strategy of the GICHD.

A risk-reduction approach goes hand in hand with an increased acknowledgement of the need timely to plan for the long-term management of residual risks—that is of those risks that we anticipate might still exist, but for which no evidence has emerged yet. We have witnessed important developments in this regard recently, especially in Southeast Asia. Several mine action strategies, for instance of Cambodia and Sri Lanka, now explicitly recognize such timely planning as a priority, and concrete action is taking place—the establishment of adequate legal, institutional, and operational frameworks in Vietnam being a case in point.

Noteworthy is also that mine action is, more than ever, understood as an enabler of broader agendas. The Sustainable Development Goals narrative to “go more connected” has certainly paved the way for that, whilst Colombia illustrated recently the positive contribution that mine action can make to peace processes. We now realize fully that being part of larger agendas is key for the sustainability and impact of our work and for others to benefit from what we have to offer.

Finally, I would mention the stronger orientation on results. As a sector, we now seek to achieve and demonstrate lasting change for what we do in terms of improved lives and livelihoods. This also responds to the wish of many mine action stakeholders for more accountability and transparency. In this same spirit, we have moved into a culture of “learning and adapting,” whereby we monitor, evaluate, and adapt our approaches constantly.

4. Going forward, what opportunities do you see for the GICHD to help the wider HMA/CWD community moving into the future?

In the development of our new strategy 2019–2022, we assessed extensively how the GICHD can best serve its partners in the future. Building on our 20-year experience in support of mine action, we believe we are well placed to promote an approach that aims to reduce risks more broadly. This is why our underlying narrative has changed from humanitarian demining to the broader reduction of risks from explosive ordinance.

A significant element of it will be to help fill gaps in the safe and secure management of ammunition. Our experience in IMAS development, outreach, and implementation will be put to good use towards a strengthened application of the IATG. The Ammunition Management Advisory Team, newly established within the GICHD together with the UN Office for Disarmament Affairs, will be a key resource to that effect.

In light of the remaining and new contamination, the need for efficient and effective mine action is undiminished. The GICHD’s core task to help develop and support nationally-owned, sustainable capacities remains in high demand and will continue to represent a key contribution of ours in the coming years. That said, we aim to enhance the sustainability of our support through an increased country focus.

I also see a continued role for the GICHD to help adapt the sector’s concepts, methods, tools, and standards to the new realities in the field. Think about operating in urban settings or dealing with more complex improvised devices. It is in the GICHD’s DNA to provide guidance on such pressing issues. At the same time, we will also lead on making established mine action concepts, methods, and tools useful for broader undertakings. The development of the Enterprise Geographic Information System (EGIS) for the OSCE Special Monitoring Mission (SMM) to Ukraine is a case in point. Fact-finding and reporting belong to the SMM’s tasks. The EGIS will facilitate this by using state-of-the-art reporting and mapping tools—well known in the mine action sector—to improve the flow of information between SMM’s field teams and its headquarters.

Furthermore, we see an increasing need for platforms for dialogue and cooperation, for example in support of the country-focused approaches currently fostered under the APMB and CCM. Regional and bilateral exchanges among affected countries also still yield untapped potential. This is a role that we are committed to offering for the benefit of our partners.

Finally, through the recent integration of the Gender and Mine Action Programme into the GICHD, we will be able to multiply our efforts to turn the gender and diversity agenda into a reality in the field. Working to see more women in mine action, involved in building solutions, and to help talented women and youth with diverse backgrounds grow in their careers, will be part of it.

5. While working in HMA, what experience, lesson, or event has impacted you in your role as Director the most?

My first mission as Director of the GICHD, two months into the job, was to Cambodia, Vietnam, and Lao PDR. What I saw there—the impact landmines and cluster munitions have had and were still having on the lives of so many people, the dedication of the mine action community to address these challenges professionally and speedily, and the positive role the GICHD was playing in supporting these efforts—all this is still with me today and represents a formidable source of motivation. What I also appreciate much is the common sense of purpose, collaboration, and solidarity that characterizes the mine action sector—sort of a victory of cooperation over competition for the benefit of a good cause. This is far from obvious and very inspiring.
1. In your opinion, what are the main conventional weapons destruction (CWD) and humanitarian mine action (HMA) obstacles faced by non-governmental organizations (NGO) operating in the Pacific (funding, strategic planning, governance, development approaches, staffing, political interference, networking of organizations within uncertain political and external environments, etc.); how are they typically overcome?

The Pacific encompasses a vast amount of area and a number of diverse HMA challenges. Golden West operations currently engages the Solomon Islands, Cambodia, Vietnam, and the Republic of the Marshall Islands, all with very different needs and challenges. Funding is always a challenge and government donors are subject to short-term budgets in the face of long-term requirements and commitments needed to build capacity to overcome HMA challenges. Donor fatigue is a reality and can have substantial impacts to organizational strategic planning, especially when you must rely on limited donors.

Golden West is different from many other Pacific HMA NGOs, who focus on clearance of landmines or unexploded ordnance (UXO). Golden West does not generally conduct clearances, but concentrates on technology and training that builds long-term capacity. Golden West operates the Explosive Harvesting Program, funded by the Office of Weapons Removal and Abatement in the U.S. Department of State’s Bureau of Political-Military Affairs (PM/WRA), and in partnership with Cambodia’s Mine Action Center (CMAC), recycling suitable munitions and creating explosive charges used by all clearance NGOs in Cambodia to destroy landmines and UXO.

2. Transitioning from the U.S. Army to an NGO, how did your past work prepare you for Golden West, and what lessons learned have been the most valuable for you?

The extended nature of Golden West training engagements requires cooperation from national authorities and recognition of the value added by the capacity we provide. Asian cultural values are often at odds to a quick approach, and it can take many years to gain trust and willing support.

The customers are also very different, and these differences have serious implications for how HMA programs evolve. In the Solomon Islands, we provide International Mine Action Standards (IMAS) EOD training for the Royal Solomon Islands Police Force. Their EOD teams are now well trained and have the skills and capacity to sustain a safe and effective program, but working in the Solomon Islands is difficult. The remote nature of the islands, the physical conditions of heat, rain, mud, and tropical jungles, helps make it a challenge just to work there.

In Vietnam, we work primarily with Vietnamese Provincial Military Commands (PMC), building EOD skills supporting both emergency responses and battle area clearances. Golden West’s PMC IMAS EOD training is focused on building long-term, sustainable capabilities that can take over when proactive clearance is done and Vietnam assumes all explosive remnants of war (ERW) missions. We are now focused on making the PMCs capable of safely and effectively managing the inevitable residual UXO without assistance.

Allan Vosburgh is the Chief Executive Officer of the Golden West Humanitarian Foundation since 2016. Vosburgh is a retired U.S. Army Colonel and former U.S. Army Master Explosive Ordnance Disposal (EOD) technician with over 40 years of experience in munitions stockpile management, explosive safety, EOD, munitions testing, weapons of mass destruction, training, technology assessments, and humanitarian mine action (HMA). Before retiring from the Army in 2005, Vosburgh served in the Office of the Assistant Secretary of Defense (Special Operations and Low-Intensity Conflict) in the Pentagon, where he provided oversight of EOD, HMA technology, and Special Operations Ammunition. Other assignments included Ammunition Officer for the Army’s Deputy Chief of Staff, Operations/G-3, Commander, 3rd Ordnance Battalion (EOD), and Director of (Ammunition) Materiel Testing at Jefferson Proving Ground, Indiana. He served as a Department of Army Civilian from 2009 to 2016 as U.S. Army, Pacific, G-4, Chief of Munitions. Vosburgh holds Master of Science degrees from both the National Defense University and Embry-Riddle Aeronautical University. He worked as a volunteer with Golden West from 2006 to 2016.
Defense (Special Operations and Low-Intensity Conflict), I worked closely with Department of Defense Humanitarian Demining Research and Development Program (HD R&D) at Fort Belvoir, VA. There I had the opportunity to interact with a wide variety of HMA NGOs and programs. The excellent work that HD R&D does within the HMA sector was a great introduction to different organizations and different approaches to the work we do. After retiring from the Army, I volunteered with Golden West for 10 years and got the chance to really know the organization before taking on the job of CEO. In terms of lessons learned, NGOs aren’t so different from military organizations I served or commanded over the years. You try to find the best people you can, provide them the resources they need, provide them clear guidance, and then get out of their way and let them do the job.

3. During your past 13 years with Golden West, how do you feel explosive hazards clearance has evolved since you became a civilian?

Mine action’s strategic environment continues to shift and evolve. Since 2005, when donors primarily focused on landmine clearance issues, we have seen growth of concerns regarding cluster munitions and a growing interest in physical security and stockpile management. The days when the large foreign mine action groups had plenty of funded work in clearing mines are largely ending and diversity of missions within the sector have become much more competitive. I am a bit disappointed that more American NGOs have not been created to support HMA. The United States is by far the biggest donor to worldwide ERW operations, yet the sector continues to be dominated by foreign HMA organizations.

In many areas, we are finally to a point where attention is shifting from proactive to reactive responses, and to examination of methods to manage residual ERW. This requires more attention to building real capacity in national programs now dominated by international NGOs, and preparing national programs to assume unilateral responsibility for HMA.

4. Going forward, what opportunities do you see for Golden West and other HMA NGOs, and how well-prepared do you think the community is for the future?

Sadly, wars continue to add ERW around the world, so I doubt there will be any shortage of opportunities for the sector in the foreseeable future. The challenge will continue to be finding adequate funding, and finding highly qualified people who want to do HMA NGO work. My concern is that a generation of military EOD operators have been forced to focus on the improvised explosive device-fight at the cost of detailed technical knowledge of ammunition and explosives. The sector badly needs EOD and ammunition experts with more than a superficial knowledge of munitions, who can also be diplomats, often working independently to train and mentor technicians and to advise host nation technical and government agencies.

5. While working in HMA, what experience, lesson, or event has impacted you in your role as CEO the most? (This could be a travel experience, people met/worked with, challenge, etc.)

I first met Senior Colonel Nguyen Quang Bieu, from the People’s Army of Vietnam when he attended an HD R&D HMA Workshop in 2003. At that time, he was assigned to the External Relations Department (ERD) of the Vietnamese Ministry of National Defense. Over the course of that week, we had the opportunity to talk and learned that we had served our respective countries in roughly the same places during 1971–1972. That war was in the distant past, but Bieu was the first former adversary with whom I was comfortable discussing it. I invited them to my home where my wife, Be, cooked Vietnamese food for all of us. Bieu and I became fast friends and we did our best to continue to keep up our discussion.

Sometime after I retired from the U.S. Army and joined Golden West, I learned that Bieu was also retiring from the Army of Vietnam. At the time, we were struggling to establish an HMA program in Vietnam and having little luck soliciting support from the ERD or other Vietnamese agencies. I suggested he might consider coming to work with Golden West.

Bieu became Golden West’s Vietnam Country Representative and soon was the key to gaining access in Vietnam. We worked together for 10 years, and he never failed to provide good counsel, even in the face of unremitting frustration. He helped guide the organization through a series of growing pains and helped me understand how to negotiate the intricacies of Vietnamese bureaucracy.

Most of all, he helped me learn that former enemies can truly be friends. His essential humanity impressed and gave me hope that all the other wars since have the potential for some sort of reconciliation. Bieu suddenly passed away in early February 2019 and was honored as a hero of Vietnam during a formal state funeral. He was my personal hero, because despite fighting serious illness, he stayed active in Golden West and our programs to aid Vietnam’s recovery from ERW. His passing was not just a loss to Golden West but to the entire HMA sector.
1. In your opinion, what are the main challenges facing the conventional weapons destruction (CWD) and humanitarian mine action (HMA) community today? How can the international community address them?

We have clear goals and the skills to free millions across the world from the fear of landmines and bombs; we have strong political backing from many places and great donors but this support needs to be expanded. The main challenge our community faces is universal political will.

Funding continues to be an issue for the sector as a whole, in many areas the amounts we need are, in global budgetary terms, not huge. More political will from some actors to contribute creatively to this financial need would go a long way. Stronger collaboration with and support for governments in affected states to enable them to fulfil their responsibilities would make our sector more cost effective and sustainable and must be delivered.

2. How has your prior experience in the humanitarian sector prepared you for being CEO of MAG? What lessons have been the most valuable for you?

I have learnt that if you stick to your principles and have high technical standards, then you'll achieve the best you can. Nearly 30 years in the humanitarian sector have given me extensive experience of solving complex problems in environments, which are physically and politically extremely difficult. The people who work in the humanitarian, CWD, and HMA sectors are very motivated and committed and they need the same thing—to have the right skills and support at the right time. Oh, and a sense of humour and humility go a long way!

3. Going forward what opportunities do you see for MAG and other HMA nongovernmental organizations (NGO) and how well prepared do you think the community is for the future?

The biggest opportunity is for HMA NGOs to be a key part of delivering a mine free world—this is a rare chance for the international community to show that when it makes a commitment, as it did over 20 years ago in the Anti-Personnel Mine Ban Convention, that it delivers on that promise.

Beyond this, the skills and knowledge that we have are unique in the NGO world and we must apply them to other problems which threaten people's safety and their futures—for example the management and destruction of small arms and light weapons and ammunition—we just need to be clearer and more creative about how we use this knowledge and skills.

4. As a strong, female leader involved in the NGO sector, what has been the most significant barrier of your career?

The biggest barrier is always if you don't believe you can do something. Once you're over that and you believe you can, then there is always a way to do anything so long as your heart is in the right place. It's a real joy to see younger women clearing this hurdle with ease!

5. While working in HMA, what experience or lesson or event has impacted you in your role as CEO the most?

Every time I travel to a MAG program, I talk to ordinary people in the communities where we work, and there is always someone who says or does something that reminds me of why we're there, and it sticks in my mind. When the day-to-day business is complicated and difficult, then remember that one person and do the right thing by them.
Landmines and explosive remnants of war (ERW) are estimated to affect the lives of two million people in eastern Ukraine, restricting freedom of movement and access to key infrastructure and livelihoods. Estimates on casualties vary widely and are often inconsistent. Nevertheless, estimates range between 1,600 and 3,600 military personnel and civilians who have fallen victim to mines and ERW since 2014.

Recent contamination in the region is the result of the ongoing conflict between Ukrainian government forces and pro-Russian separatists in Luhansk and Donetsk oblasts. Although the full extent of contamination is unknown, conservative estimates suggest that about 20 sq km (7.72 sq mi) are contaminated.

Currently, at least three government institutions are directly involved with humanitarian demining, with the support of three international NGOs. Many more organizations are involved in mine risk education (MRE), victim assistance, stockpile destruction, advocacy and training, advisory, and coordination of the mine action program. However, until January 2019, there was no strong legal framework to orchestrate these efforts. This article describes the current legal framework for mine action in Ukraine, analyzes the legislative process and bureaucratic impediments, and briefly discusses the different prospects of the newly-adopted mine action law.

Legislative Process

Representatives of mine action stakeholders in Ukraine agree that the obstacles to passing national legislation were not technical. Throughout the years, the mine action community has consolidated lessons learned and developed best practices for developing national mine action laws. Moreover, international organizations have provided direct support to the Ukrainian government in helping to overcome any technical obstacles. Yet, a specific legislation on mine action was approved only recently by the Ukrainian government. On 6 November 2018, the Verkhovna Rada (Parliament) of Ukraine conducted the first reading of draft law No. 9080-1. However, it was returned for further amendments, and international organizations were asked to present their thoughts and suggestions. The second reading of the bill took place exactly one month later, and the legislation was approved on 6 December 2018. The draft law was then forwarded to the Cabinet of Ministers, which approved the legislation on 25 January 2019.

Instead of technical issues, the main challenges seemed to be of a political nature, as the very exercise of passing a law is a strenuous and time-consuming process. Moreover, the ongoing conflict has taken up most of the political attention and resources. Parallel to the conflict, the 2014 revolution triggered a series of reforms that are still taking place and most likely will continue to require political attention. The new mine action legislation will inevitably lead to another reform, which would affect roles, responsibilities, and budgeting among government authorities. Needless to say, such changes are likely to prompt internal friction and disagreement.

Mine Action in Ukraine

The new law “On mine action in Ukraine” lays the legal and organizational groundwork for conducting mine action in Ukraine and also highlights the peculiarities of exercising state regulation in this area. The law defines “the legal ground, objectives and principles, national interests of Ukraine in the mine action ambit, a list of the mine action objects and entities, the procedure of their creation together with organizational and procedural principles of operation; requirements to mine action and demining specialists and their responsibilities; mine action sources of financing; the registration procedure for mine action operators, rendering assistance to blast victims, framing the status of territories intended for mine action purposes, etc.”

Importantly, the law calls for a civilian-led mine action center, in order to “[provide] for regulations that govern democratic civic control in the field of mine action, the national interests of Ukraine in the field of mine action, the principles of international cooperation and implementation of economic activities in the field of mine action, including liability insurance during mine clearance and public procurement in the field of mine action.” The law also establishes the grounds...
for procuring contracts for mine action services and provides liability for violating the mine action legislation.\textsuperscript{13}

The new legislation is to be implemented by mid-2019, including the establishment of both the National Mine Action Authority and Mine Action Center.\textsuperscript{12} It provides the necessary legal framework and institutional structure to advance the mine action program in Ukraine. However, because the law was passed after the 2019 budget had been approved, there is no dedicated government budget for its implementation.\textsuperscript{19} Therefore, it is still uncertain how and when the law will be implemented.

\section*{Before and After the Mine Action Legislation}

Prior to the conflict, a presidential decree established a National Mine Action Authority (NMAA) in Ukraine on September 2013. The Ministry of Defense’s (MOD) Department of Environmental Safety and Mine Action was tasked to coordinate the in-country mine action program, acting as the secretariat for the NMAA.\textsuperscript{3} At that time, the focus was on the destruction of stockpiles and legacy ERW from World War I and II.\textsuperscript{20}
After the conflict erupted in 2014, the scope of the problem increased substantially, and many other actors joined the demining effort, including different government bodies, international organizations, NGOs, and the private sector. Although the MOD remained the de facto coordinating body for humanitarian demining, it did not have the required authority over other ministries and government institutions currently involved in mine action. The coordination of MRE activities, for example, was mostly undertaken by the United Nations Development Program (UNDP)-led mine action subcluster, but not without flaws.21 There was sometimes poor or no coordination among partners performing MRE, with a high risk of leaving gaps in some areas and duplication of efforts in others.21 Likewise, local civil authorities in mine-affected communities did not seem to be informed about the scope of the problem and the location of hazardous areas in their region, let alone the current demining plans and activities.22

According to the mine action legislation passed in late January 2019, the new National Mine Action Authority should be “a permanent interdepartmental collegial authority, set by the Cabinet of Ministers of Ukraine.”18 This structure should allow for better coordination among the different governmental authorities currently involved in mine action, although the challenge of ensuring local-level mine risk awareness and program support remains.

While Ukraine’s MOD is understandably mostly preoccupied with the ongoing conflict, it will remain the responsible authority for the prioritization of clearance tasks until the establishment of the National Mine Action Center by 25 April 2019. However, while immediate emergency and short-term security needs are a logical priority from a defense and security perspective, this might at times be contrary to long-term socioeconomic perspectives and humanitarian objectives. For example, certain existing minefields might be regarded by the military as a necessary defensive obstacle and not be prioritized for clearance, even though it affects a large number of civilians.

In the absence of national standards, Ukraine adopted the International Mine Action Standards in September 2016 as a provisory measure until National Mine Action Standards (NMAS) were approved.3 With the support of international actors, the MOD has drafted different NMAS since 2016. However, even though most mine action operators had agreed to follow them, the standards were not binding without national legislation to enforce them.23 The MOD finalized the NMAS in late 2018 and, with the endorsement of the newly-passed national mine action legislation, expects to fully implement them by the end of 2019.18,24

However, as one of the consequences of the delayed legislation, there have been inconsistencies throughout the mine action program in Ukraine. First, the Ministry of Temporarily Occupied Territories and Internally Displaced Persons, for example, had developed its own standards for MRE, which then competed with the MOD’s. Second, information management has been subject to duplication of efforts and discrepancies. At least two main mine action datasets are currently in place, one managed by the MOD and another by the State Emergency Services of Ukraine (SESU). There has been no clear division of responsibilities for data collection, especially for mine and ERW casualties, perhaps explaining the inconsistency and probable underreporting seen in this area.16,25 Moreover, the standards used for data entry differ from common international practice, leading to grossly overestimated figures for clearance activities.26 The new legislation attempts to tackle those issues by abiding to the Information Management System for Mine Action and centralizing information under the National Mine Action Center.18

Unfortunately, compulsory accreditation and quality management processes were only recently established by the new mine action law.14 Humanitarian demining organizations have operated under individual memorandums of understanding with the MOD and are tasked by its Coordinating Group for Mine Action. Clearance procedures
were not externally verified before, during, or after execution and cleared land could not be officially released for use by the population. In the end of September 2018, the Ministry of Defense started its own accreditation process, but like the NMAS, they are only enforceable if backed up by the national legislation. The current legal framework establishes an Accreditation and Monitoring Commission, but that is yet to be implemented.

Until the NMAA is established, stakeholders need to deal with multiple interlocutors and risk miscommunication. A European Union (EU)-funded project in support of the State Special Transport Service’s demining teams had to be closed after it was transferred from the auspices of the Ministry of Infrastructure to the MOD, because the EU could not support the Ukrainian military due to their funding policies. Some argue that the lack of a specific legal framework caused concern and mistrust among prospective donors, thus limiting the availability of international funding. In order to address these concerns, the newly established NMAA will be responsible to act in the name of the state when dealing with international organizations within the sphere of mine action.

An additional flaw was that the previous legal framework for mine action did not cover specific compensations and assistance for mine victims, deminers, and citizens who lost access to their livelihoods due to mine and ERW contamination. In fact, Ukrainian law only now distinguishes mine victims from other conflict-related victims. Even though the new legislation accounts for medical and socio-psychological support for victims of explosive ordnance, it only grants a one-time monetary compensation for persons under 18 years old. Moreover, it does not address many of the legal disputes that may arise in terms of land rights and compensation for lost livelihoods.

Finally, the absence of specific procurement provisions—an issue not addressed by the new legislation—has hindered import and usage of dual-use equipment and vehicles, such as mine detectors, armored vehicles, and explosives. International operators face a series of bureaucratic impediments to import dual-use material and until this day are not authorized to dispose of the mines and ERW found during clearance operations. Instead, the MOD or SESU explosive ordnance disposal (EOD) teams are required to dispose of items. This current practice puts an unnecessary burden on EOD units, slows down clearance operations, and leaves mines and ERW exposed for longer periods of time, increasing the risk of accidents and criminal use of the ordnance.

Despite the general excitement with which the mine action community received the newly adopted legislation, the law has raised serious concerns especially among donors. Article 8 states that “donor-sponsored financial resources are credited to a special fund of the state budget under the relevant budget programs.” In other words, donor funding should be pooled and managed by a government organization, and not directly by the implementing partners. While this provision was supported by representatives of the defense and security industry, it is unacceptable for most donors and could result in a large decrease, if not cessation, of funds from international donors. Nonetheless, Articles 20 and 28 assign the Ukrainian Cabinet of Ministers the responsibility to regulate mine action operators who are directly funded by donors. This raises the question of the legality of direct donor funding. The issue was raised, and member of parliament Ivan Vinnyk proposed the Ukrainian Parliament vote in the plenary session on whether to direct donor funding of mine action, but the vote did not pass, and the question remains unanswered. Although the law is still valid, humanitarian mine action funding is at risk and is already impacting donor funding decisions relating to the future of continued mine action operations in Ukraine.

Conclusion

Until January 2019, Ukraine did not have a national mine action legislation. However, the lack of specific legislation was not an insurmountable challenge for humanitarian demining and related activities. While important for addressing practical issues, such legislation is a crucial step toward ownership, and is an opportunity for a fresh start, to rectify working relationships, and adopt new procedures and higher-quality standards.

Moreover, the new law is necessary to unleash the full potential of mine action in Ukraine by de-conflicting competing efforts and facilitating bureaucratic procedures. Furthermore, the new mine action law shows Ukraine’s commitment to addressing the problem of contamination by mines and ERW and may enhance donor trust in funding a national program. Nevertheless, while the newly adopted legislation has clarified many inconsistencies of the Ukrainian mine action program, it has also shown significant gaps and created further uncertainty, especially in relation to direct donor funding and government budget for its implementation.

Finally, while the new legislation is important now, it will be much more so when the conflict calms down. As the conflict in eastern Ukraine decreases in intensity and full clearance starts in the buffer zone, the number of operators and donors will likely increase, as will the need for better coordination and resource management. For now, with the support of international organizations, Ukrainian authorities bear the greatest responsibilities in implementing the mine action legislation.

Henrique Siniciato Terra Garbino
Swiss Foundation for Mine Action
Uppsala University, Department of Peace and Conflict Research

Henrique Garbino served in the Brazilian Army from 2006 to 2017 as a combat engineer officer and an EOD specialist. He is currently a master’s student at Uppsala University Department of Peace and Conflict Research and, as part of the Rotary Peace Fellowship, he was posted for three months to FSD programs in Tajikistan and Ukraine.
The HALO Trust (HALO) has been working in Ukraine since 2015, a year after the hostilities in the east of the country began. Both the ongoing conflict in the Donbas and tensions on the border with Russia have left large areas of land contaminated with landmines and other explosive remnants of war (ERW). In places where the frontline has moved on and the fighting has stopped, mines and other ERW remain, preventing the lives of civilians from returning to normal.

HALO currently has around 400 full-time staff employed in Ukraine and is conducting manual and mechanical clearance, non-technical and technical survey, risk education, and some capacity building with state authorities to enhance their capabilities to carry out humanitarian survey and data gathering. HALO’s program in Ukraine is currently funded by the United States, United Kingdom, Germany, Norway, the Netherlands, Belgium, and Finland, and has received funding in the past from Switzerland, the Czech Republic, and the European Union.

As in every part of the world, Ukraine has its own set of challenges that affect humanitarian mine clearance. The key challenges facing humanitarian mine clearance in Ukraine relate to the main threat types encountered: tripwire-initiated devices and both metal- and minimum-metal anti-vehicle mines. There are additional challenges relating to the specifics of the Ukrainian context: demining in an active conflict zone, working without explosives, and the extreme weather conditions. New techniques and technology, some tried and tested in other countries, are being explored. These are too numerous to list; however, we will discuss a few of the key ways HALO is overcoming some of the challenges of conducting humanitarian mine clearance in Ukraine.

Context
The two regions of Donetsk and Luhansk are currently in a de facto state of division between the territory controlled by the government
of Ukraine and separatist non-government controlled areas (NGCA). The terms of the Minsk ceasefire agreement created a 15 km (9.3 mi) buffer zone on either side of the line of contact between the two opposing forces and forbade the stationing of heavy weaponry within the zone. Despite the agreement, shelling and crossfire between both sides occurs on an almost daily basis.

Land inside the buffer zone and on the line of contact is heavily contaminated with landmines and unexploded ordnance (UXO).

While the location of the line of contact now remains largely static, in 2014 and 2015 it was far more fluid with large areas of territory regularly changing hands during the fighting. This has resulted in widespread mine and UXO contamination, not just along the current line of contact but also within and outside of the buffer zone. Additionally, civilians continue to live in areas where neither side has full control, commonly referred to as the grey zone. Here the threat from landmines and UXO is also prevalent.
Ukraine is a Party to the Anti-Personnel Mine Ban Convention (APMBC) and in 2018 received approval of its request to extend its deadline to 1 June 2021 to clear its territory of all known anti-personnel minefields. However, the extension request stated that achieving these obligations was dependent on “…completion of hostilities, restoration of the constitutional order and gaining the full control over the occupied territories, including over the state border between Ukraine and the Russian Federation.”

Currently HALO is only able to work in areas controlled by the government of Ukraine and is working across both oblasts inside and outside the buffer zone. HALO is unable to work on the line of contact or the grey zone but teams are working to survey and clear areas close by where the threat of mines and UXO is affecting the civilian population. Therefore the challenges outlined only refer to the areas within eastern Ukraine where HALO works. They do not refer to the nature of the mine and ERW problem in areas of Ukraine where HALO is not working; the grey zone, the line of contact itself, and the NGCAs, which may differ in terms of threat type.

Ukraine-Specific Challenges

Operating in conflict-affected regions.

While the intensity of the conflict in Ukraine has decreased since the heavy fighting of 2014, indirect fire and shooting close to the line of contact remains a reality. HALO does not work in areas where there is a threat of mines being relaid. However, the buffer zone contains the most areas with mine contamination, and this means there is a need to work in some areas that are only a few kilometers from the line of contact. Although civilians and NGOs are not deliberately targeted, working in such close proximity to the line of contact does present a risk to demining teams from stray indirect fire. Careful consideration of the security situation in those particular areas is required before demining teams deploy close to the line of contact. If shelling occurs nearby or there has been a major escalation close to the minefield, work is suspended and teams moved in order to guarantee the security of demining staff. HALO does not deploy teams in those areas where there is a high threat of indirect fire or close to active military positions; however, there are inevitably times when demining teams within the buffer zone have to suspend work and are moved as a safety precaution.

Destruction of items.

Humanitarian demining operators do not yet have access to explosives in Ukraine, nor permission to carry out render-safe procedures. This hinders the work but is not an insurmountable problem. Rather than conducting demolitions, the destruction or removal of ERW requires close coordination with the State Emergency Service (SES). When HALO finds a mine or item of UXO, the SES is contacted and their assistance is requested. Although this generally works well, the situation in Ukraine means that the explosive ordnance disposal (EOD) capacity of the SES is often over-stretched. In some cases the lead time between the discovery of an item and its removal can be a number of days. In cases where the device poses a particular danger such as where a tripwire-initiated device is discovered, deminers have to be moved a safe distance away to work elsewhere on the minefield. Where there is a significant delay in a device’s destruction or removal the clearance strategy of the minefield can be disrupted.

Challenges in the Minefields

Non-technical and technical survey.

The nature of mine clearance is that the majority of the time the mines remaining in a contaminated area are buried or concealed. Therefore in order to avoid clearing land unnecessarily non-technical and technical survey methods are used. Where minelaying has been conducted in a uniform pattern, technical survey methods can be useful. Technical survey involves conducting limited clearance to find exactly where a mine-line is, enabling the follow-up clearance of the minefield to be more targeted and avoiding the need to clear areas far from the identified pattern.
The type of minelaying in Ukraine varies between professionally laid defensive belts placed in a clear uniform pattern, such as a line of evenly spaced anti-vehicle mines across a field, and sporadic minelaying. The latter being due either to low-level tactical considerations dictating the logic of where small numbers of mines have been placed or because of nuisance minelaying conducted by non-professional soldiers or combatants.

The prevalence of this sporadic minelaying can often severely limit the usefulness of technical survey. It is difficult to find a pattern when there was no pattern or where the logic of the minelaying was down to tactical rather than geographic considerations relevant at the time.

Even in the case of defensive minefields laid in a clear uniform pattern by professional military units, an operator’s ability to conduct technical survey can be limited if a large number of mines have already been removed by military forces or the local population. These minefields still require clearance because some mines may have been missed. However, by removing mines from an area, the original pattern becomes obscured and establishing where the mine-line was can be difficult. This can result in larger amounts of clearance needing to be conducted in order to find a relatively small amount of mines.

Aids to non-technical survey. In cases where minelaying is sporadic and the benefits of technical survey are limited, good quality non-technical survey becomes ever more important. Where it can be difficult to establish a pattern or logic to the minelaying through technical survey or the early stages of clearance, information from local communities and other informants can often help mitigate this. A good understanding of the tactical situation in a particular area at the time of the minelaying can often be far more effective than trying to rely on traditional technical survey methods. Moreover, there is an archive of high-quality satellite images of Ukraine available on Google Earth. Given that the minelaying is relatively recent, predominantly 2014-2015, these images sometimes reveal evidence of minelaying that is no longer visible on the ground. An example of this are the tracks from a military minelaying machine, as shown in Figure 3. Such imagery aids the accuracy of non-technical survey and can eventually lead to more efficient clearance.

Clearing tripwire-initiated devices and minimum-metal mines. The most common devices encountered by HALO in Ukraine are tripwire-initiated hand grenades, anti-personnel bounding-fragmentation mines (OZM-72s), both metal-cased and minimum-metal anti-vehicle mines (TM-62 and TM-62P), and directional fragmentation mines (generally the MON series of anti-group mines). There is also the threat of UXO, ranging from small-caliber cannon rounds to large-caliber mortar rounds. Furthermore, many minefields contain a combination of different threats. Open media sources document that anti-personnel blast mines such as PMN-2s and MS-3s, along with a range of improvised devices and booby-traps, have also been used in the conflict, but at the time of writing HALO has not found these types of items during its clearance operations in Ukraine.

The possibility of a wide variety of threat types, including tripwire-initiated devices, has to be considered when clearing an area. Of land currently surveyed by HALO and remaining to be cleared, 75 percent has a potential tripwire threat. The remaining 25 percent are anti-vehicle mine-only tasks, of which 12 percent are minimum-metal mines and 13 percent are metal-cased mines.

Minefields that involve the clearance of tripwires, or minimum-metal anti-vehicle mines, are slower to clear than land with metal...
anti-vehicle mines only, without the threat from tripwire devices. Additionally, unlike many countries with a historic legacy of mine contamination, most of the tripwires in Ukraine are still intact, having only been laid within the last five years and being made of either metal or nylon. This means metal detectors cannot be relied upon alone as a means of searching for tripwires. As a result, a visual drill involving the use of a fiber rod to guide the eye followed by the incremental removal of vegetation is required. This is intrinsically slow when compared with clearance methods for other threat types (as shown in Figure 4).

In minefields where there is only a threat of metal anti-vehicle mines, deminers can conduct clearance by walking over the suspect ground with a large-loop metal detector with the sensitivity calibrated to the mine-type. Deminers then manually investigate metal signals. This process enables clearance rates of over 50,000 sq m (59,800 sq yd) per team per month. This process is slowed, however, when the threat of tripwire-initiated devices is also a possibility. In such instances the slower tripwire search must be conducted across the minefield before a large-loop detector can be used to look for the buried anti-vehicle mines. Therefore, what would ordinarily be a relatively fast method of clearance is slowed to an average rate of 5,000 sq m (5,980 sq yd) per team per month, by the presence or suspicion of tripwire-initiated devices.

The clearance of areas where the threat of minimum metal anti-vehicle mines is suspected also poses challenges and is often slow compared with searching for metal-cased mines. This is due to the need to use more sensitive detectors to locate the mines, which inevitably also results in more signals from small metallic clutter being picked up that have to be investigated through manual soil excavation to determine whether a threat exists. This problem is exacerbated by contamination from shelling thereby increasing the levels of metal clutter in the soil. Moreover, Ukraine’s famously fertile chernozem soil is heavily mineralized, further limiting the range of suitable detectors. While the challenge of searching for minimum-metal mines is not unique to Ukraine, in places where this threat is combined with a need to search for tripwire-initiated devices, it results in a significantly more time-consuming process when compared with clearing other types of mines.

New Detectors

HALO is anticipating deploying a team with combined ground penetrating radar (GPR) and metal detectors in 2019. The GPR detectors should enable metallic clutter to be distinguished from anti-vehicle mines. By being able to better distinguish between clutter and the profile of an anti-vehicle mine, teams can rapidly excavate clutter, leaving the remaining signals to be excavated as per standard procedures. This should increase the efficiency of clearing anti-vehicle minefields where there are large amounts of metal fragmentation from shelling. Such detectors have had a significant
make excavations incredibly slow and grueling. Enabling work to continue in such conditions relies on using creative methods and respecting the tough conditions the teams are working in. Ensuring teams are equipped with suitable clothing and boots and have the facilities and time required to warm up on the minefields is fundamental. In such conditions it is crucial to ensure deminers are able to maintain concentration to ensure safe and efficient work.

**Mechanical assets.** HALO Ukraine is building its mechanical capacity and currently the program has two front loaders and is looking into further mechanical options. The front loaders are currently being used to clear areas such as former military positions that are difficult and slow for manual teams. Having a mechanical capacity also enables some clearance teams to be deployed through the winter months.

2019 will see the trial and deployment of lightly armored remote vegetation cutters. The objective of these machines is to support manual teams by cutting the vegetation ahead of their progress on a task. It is expected this will improve the efficiency of the drill by speeding up one of the most time-consuming parts of the process: the careful investigation and removal of vegetation. Depending on the success of these machines, a lighter equivalent will be considered with the aspiration to deploy them onto minefields where there is a mixed threat of devices such as tripwires and anti-vehicle mines.

**Melting frozen ground.** During winter, fires are lit in safe areas within the minefields to heat up a saline solution and provide warmth during breaks. The saline solution is used to thaw frozen ground. When a metal signal has been identified and isolated, the hot liquid is then poured over the soil. The ground is then covered with cut vegetation, which acts as insulation trapping the warmth. This process enables the ground to thaw overnight and makes soil excavations possible the following day.
Looking Ahead

Beyond security and access restrictions, the primary challenges of conducting humanitarian mine clearance in Ukraine are from tripwire-initiated devices and minimum-metal anti-vehicle mines. HALO Ukraine is developing both technical and human methods to overcome the challenges posed and to increase the efficiency of clearing land. This involves using techniques and technology used elsewhere in the world but also requires the trialing of new ideas and innovations. Similarly, the challenges of working within the context of Ukraine are, where possible, also mitigated and overcome through innovative means and where necessary through liaison with state bodies.

Ultimately the importance of optimizing clearance rates and increasing the efficiency of HALO’s work in Ukraine is to remove life-threatening hazards from ERW contaminated land. The more efficiently minefields can be cleared the faster land can be returned for use by landowners and the community. Restoring land to its original state helps the lives and livelihoods of those living in affected areas return to normal.

Although seeking new innovations is important, the majority of the work is ultimately done by Ukrainian men and women. High-quality training provides the skills required to clear the land. Oversight and guidance from experienced demining team leaders and supervisors in the field ensures that safety is maintained and the quality and thoroughness of HALO’s clearance remains to the highest standards. It is therefore the quality of HALO’s personnel that is the most important factor. Developing their skills and building their experience allows HALO to deliver its lifesaving work despite the challenges faced within Ukraine.

See endnotes page 69
Since fighting began in 2014, significant areas of the Donetsk and Luhansk regions in eastern Ukraine have been contaminated by landmines and unexploded ordnance (UXO). This article will briefly cover the origin of the OSCE Special Monitoring Mission to Ukraine (SMM) and its mandate, before turning to the types of contamination observed by the SMM in eastern Ukraine. On 21 March 2014, the 57 participating States of the Organization for Security and Co-operation in Europe (OSCE) made a consensus decision to deploy the SMM, and the SMM's mandate has been extended each year since. The SMM establishes facts and reports on the security situation across Ukraine, monitors and supports respect for human rights and fundamental freedoms, and facilitates dialogue.

The SMM has around 600 unarmed civilian monitors in eastern Ukraine who patrol accessible areas in the Donetsk and Luhansk regions. The presence of explosive remnants of war (ERW) forms a major impediment to the SMM's freedom of movement across these regions, a fact tragically highlighted by a fatal incident on 23 April 2017 near Pryshyb, after which the SMM's patrols have been limited to asphalt and concrete surfaces only.1

In terms of mine action, in signing the Minsk memorandum in September 2014, the sides have already agreed to remove all mines and not to install or lay mines in the security zone.2 There is an urgent need to clear contaminated residential areas, and items of ERW pose a serious danger to civilians crossing the area between the forward positions of the Ukrainian Armed Forces and those of the armed formations.3
Lack of Information  
One of the key problems from a mine action perspective is the lack of comprehensive non-technical surveys (NTS) in the Donetsk and Luhansk regions, owing—among other factors—to a lack of access to large areas of the contact line as the conflict remains active.\(^4\^5\) Many important NTS have been done, in particular in government-controlled areas, but the international and government organizations that undertake surveys are mostly unable to work in the contact line area for obvious reasons, and no known form of NTS has been undertaken in the non-government-controlled areas.

This lack of information is a key impediment to the SMM, as it undertakes its work in the Donetsk and Luhansk regions and directly affects the safety of SMM patrol teams. For this reason, as well as overall monitoring of commitment to the Minsk memorandum, the SMM—while not a mine action organization—takes a keen interest in the presence of ERW, reporting on these in its daily reports. This information comes not just from SMM patrol teams on the ground—which have unique access to many areas on both sides of the contact line—but also via the use of unmanned aerial vehicles (UAV), which help the SMM to overcome some of the freedom of movement restrictions imposed by the presence of ERW.

Anti-tank and Anti-vehicle mines (ATM/AVM).\(^6\) By far, AVMs comprise the most prevalent type of mine contamination observed in the Donetsk and Luhansk regions. The most common AVM type is the TM-62M, with the plastic-bodied TM-62P3 also being observed in fewer numbers. An unusual feature of the mine contamination observed by the OSCE SMM, compared to comparable minefields in other contemporary conflicts, is the prevalence of surface-laid AVM minefields. These range from small minefields across tarmac roads that comprise only a few mines to surface-laid minefields across large open fields. An SMM UAV recently identified a surface-laid linear minefield, most probably laid by a mechanical minelayer, which was 2.7 km (1.7 mi) in length and contained an estimated 900 AVM.\(^7\)

The TM-83 off-route AVM has also been observed in small numbers in the Donetsk region, seen for the first time by the SMM in 2019.\(^8\) Additionally, parts of the coast in the Donetsk region are known to be contaminated by PDM-1M amphibious mines. SMM monitors observed some of this mine laying taking place, and the same event was widely reported in open source media.\(^9\)

Anti-personnel mines (APM). Prior to the start of hostilities, the government of Ukraine had declared that no APM were emplaced on Ukrainian territory. With the subsequent emplacement of such mines, Ukraine in 2018 requested an extension of its deadline under the Anti-Personnel Mine Ban Convention (APMBC) to remove them. The Meeting of States Parties to the APMBC granted the extension, until 1 June 2021, at its 17th meeting in November 2018.\(^10\)

The SMM has observed a number of APM types across the Donetsk and Luhansk regions. The OZM-72 bounding APM have been observed across the conflict area, and has been reported on by the SMM on numerous occasions.\(^11\) Other AP mine types observed include the MON-series directional APM and the POM-2 APM.\(^12\) The SMM has also observed...
other evidence of APM use, such as the presence of the plastic cruciform-shaped tripwire launchers from POM-2 APMs scattered across tarmac roads in close proximity to the Donetsk water filtration station. OSCE monitors have been present during the demolition of PMN-2 APMs by the Ukrainian Armed Forces.\textsuperscript{13,14}

**Unexploded ordnance (UXO).** The SMM has observed and reported on thousands of items of UXO on both sides of the line of contact. These range from small-arms ammunition all the way up to unexploded 300 mm Multiple Launch Rocket System (MLRS) rockets. An exhaustive list of all types of explosive hazards is beyond the scope of this article.

Explosive ordnance disposal (EOD) teams conduct spot tasks on both sides of the contact line, and the SMM has enjoyed some success in reporting items of UXO to the respective sides and advocating for their removal.\textsuperscript{15} However, an area of difficulty is the area between the forward positions of the Ukrainian Armed Forces and those of the armed formations, where neither side is able or willing to risk their personnel in clearing items of ERW left behind by shooting.\textsuperscript{2,3}

On several occasions, the SMM has observed items of ERW lying at the entry-exit checkpoints between the two sides.\textsuperscript{2} These entry-exit checkpoints are already dangerous places for civilians, who are exposed to long queues in areas that lack adequate shelter, water, or proper sanitary resources, and who sometimes come under fire. The presence of ERW in close proximity, sometimes only a few meters away from queueing pedestrians or vehicles, only adds to these risks.

As an example, a PG-7L round was observed on 7 March 2017, lying on the H15 highway in the area between the forward positions of the Ukrainian Armed Forces and those of the armed formations.\textsuperscript{3,16} This entry-exit checkpoint is one of the busiest and is used by thousands of civilians a day. Owing to the lack of EOD capacity able to work in the area between the forward positions, the round remained on the highway for several days, indicated with informal marking, before disappearing, probably removed by a civilian.

Another issue of particular note is the presence of high-explosive bullets across the conflict area. The 12.7 mm MDZ snap action incendiary round has a small, high-explosive charge. A number of civilian casualties have been attributed to this round, with some occurring to young children who have picked them up. Painted bright red, they are often mistaken for standard incendiary rounds, and people are usually unaware of the dangers associated with them.

**Conclusion**

The lack of information on the mine contamination situation in the Donetsk and Luhansk regions of Ukraine remains one of the key dangers to civilians in eastern Ukraine, as well as being one of the main impediments to the SMM’s freedom of movement in the area. Forwarding information about facts on the ground, including the risks posed to civilians by ERW, is one way that the SMM makes a contribution toward a safer, more secure environment for civilians.\textsuperscript{6}

\textsuperscript{See endnotes page 69}

Edward Crowther
Monitoring Officer
OSCE Monitoring Mission to Ukraine

Edward Crowther is a Monitoring Officer with the OSCE Special Monitoring Mission to Ukraine. Prior to joining OSCE, he worked for Danish Demining Group in Ukraine and Afghanistan, and The HALO Trust in Angola and Sri Lanka. He holds a Master of Science in development studies from the University of London’s School of Oriental and African Studies (U.K.).
A PHOTO ESSAY BY ROCCO RORANDELLI

MINELAND

THE ENDLESS WAR

Many modern conflicts leave behind unexploded ordnance (UXO) in their aftermath, inflicting severe human, social, and economic costs. Europe is not immune from this issue. Today, landmine-affected countries in Europe include Croatia, Bosnia and Herzegovina, Kosovo, and Serbia. With an average removal cost of €1,000 per mine, insufficient funding is the main reason why demining is still unfinished in this region after more than 20 years of work.1–5 Every year, deminers and civilians die or are injured because of ordnance explosions.

A common sentiment of all organizations involved in demining operations is that greater funds are required to increase clearance capacity and demining in a timely manner. The goal of this project is to bring the current situation in the Balkans to the public attention. The following photographic documentation includes aerial photographs of minefields and demining operations as well as still-life images of exploded ordnance, tools used by deminers, prosthetic limbs, and survivors.  

See endnotes page 70

19 April 2016. Pristina, Kosovo. A prosthetic leg made by the Orthopaedic Research Society (ORS) for a 31-year-old male landmine survivor. ORS is a Kosovo-based company working with German manufacturer Ottobock. While governmental prosthetic legs cost about €500, ORS products range from €2,000 to €6,000. Survivors can afford prosthetics only through foreign-sponsored grants.
22 April 2017. Assia, 76, by her home in the hills above Sarajevo. She stepped on an anti-tank mine, probably activated by an anti-personnel mine. In the explosion, she lost her legs, an arm, and severely injured her back. Doctors say that it is a miracle she survived. “After the explosion, there was a crater where we could have parked a car,” says her son, who today takes care of Assia.
20 April 2016: Banjice, Drenas, Kosovo. A deminer working inside a 30,000 sq m (35,880 sq yd) minefield close to the village of Banjice. This minefield is planted with PMA-1 anti-personnel mines from the Yugoslavian army. Two villagers have died; one lost a leg, and one an eye in this minefield.

20 April 2016: Doganaj, Kosovo. Deminers work in a 100,000 sq m (119,599 sq yd) minefield located along a main road in Doganaj, contaminated by NATO BLU-97 cluster bombs.
23 April 2017. Sarajevo, Bosnia and Herzegovina. Alija Svraka, born in 1960, is president of the association for invalids, with 120 members in Sarajevo, 50 percent of which are due to mines. While a soldier, he lost his legs in 1994 in Nišici while walking, sixth in line, in a column through a meadow.
10 July 2016. Kotur, Sisak, Croatia. A path separating a demined portion of the forest (top) and the contaminated portion of the forest that remains to be cleared (bottom).

1 July 2016. Doboj, Bosnia and Herzegovina. The fertile agricultural area of Doboj is the most heavily mined in the country. Here, a deminer working for The HALO Trust is probing the ground along the borders for landmines. The area has already been cleared by a demining machine; however, clearance does not guarantee areas to be 100 percent mine-free, especially along borders.
22 April 2017. Vitez, Bosnia and Herzegovina. Anita Vidovic, 26 years old, works for Caritas Bosnia in Sarajevo as a kindergarten teacher. She lost her right leg in Dubravica on 1 April 2001. She was walking with her family along a path near her home, last in line, when she stepped on a mine. In the explosion, she lost her leg, and her cousin and aunt were injured. With her disability, she receives payments of about €90 per month. “I think in BiH people don’t talk enough about this problem, which seems to be hidden under a carpet.”
4 July 2016. Dabar, Otočac, Croatia. A deminer walking inside a 1.8 sq km (0.7 sq mi) minefield. Demining was done in 2 shifts, from 8:00 to 13:00 and 13:00 to 18:00, with 50 deminers for each shift. On average, the cost to demine 1 sq km (0.4 sq mi) is €1 million.

13 April 2016. Zagermlje, Pejë, Kosovo. The controlled explosion of collected landmines in a 42,500 sq m (50,830 sq yd) minefield, discovered in 2015. Deminers have thus far recovered 34 unexploded mines.
23 April 2017. Sarajevo, Bosnia and Herzegovina. Nizam Cancar, 42 years-old, has played with the Phantom club sitting-volleyball team since 1996, and won a gold medal at the London Olympic games and a silver medal at the Rio de Janeiro Olympic games. On 6 October 1994, he lost his leg while working as a deminer and receives payments of €220 per month. Exactly 22 years after his accident, on 6 October 2016, his son was born. “Our government has a problem talking about mines.”
19 April 2016.  
Hoqe e Qytetit, Kosovo. A part of a deflagrated BL-755 cluster bomb.

20 April 2016.  
Zagermlje, Pejë, Kosovo. Remains of an exploded BLU-97 UK-made NATO cluster bomb.

Rocco Rorandelli
Rocco Rorandelli (Italy, 1973) started working as a documentary photographer after his studies in zoology, which helped him develop a profound interest in global social and environmental issues. His images have been utilized in several awareness campaigns of intergovernmental and non-governmental organizations, and published by the main international magazines, such as The New York Times, Le Monde Magazine, GEO, Der Spiegel, Newsweek, The Wall Street Journal, Paris Match, Guardian Review, D di Repubblica, L'Espresso, Internazionale, Io Donna, Vanity Fair, Monocle, IL, and many others. In 2011, he was awarded a grant by the Fund for Investigative Journalism for his long-term project on the tobacco industry. Rorandelli is based in Rome and is one of the founding members of the collective TerraProject.

Website: http://terraproject.net/photographers/rocco-rorandelli

19 April 2016.  
Hoqe e Qytetit, Kosovo. A part of a deflagrated BL-755 cluster bomb.

20 April 2016.  
Zagermlje, Pejë, Kosovo. Remains of an exploded BLU-97 UK-made NATO cluster bomb.

Rocco Rorandelli
Rocco Rorandelli (Italy, 1973) started working as a documentary photographer after his studies in zoology, which helped him develop a profound interest in global social and environmental issues. His images have been utilized in several awareness campaigns of intergovernmental and non-governmental organizations, and published by the main international magazines, such as The New York Times, Le Monde Magazine, GEO, Der Spiegel, Newsweek, The Wall Street Journal, Paris Match, Guardian Review, D di Repubblica, L'Espresso, Internazionale, Io Donna, Vanity Fair, Monocle, IL, and many others. In 2011, he was awarded a grant by the Fund for Investigative Journalism for his long-term project on the tobacco industry. Rorandelli is based in Rome and is one of the founding members of the collective TerraProject.

Website: http://terraproject.net/photographers/rocco-rorandelli

Rocco Rorandelli
Rocco Rorandelli (Italy, 1973) started working as a documentary photographer after his studies in zoology, which helped him develop a profound interest in global social and environmental issues. His images have been utilized in several awareness campaigns of intergovernmental and non-governmental organizations, and published by the main international magazines, such as The New York Times, Le Monde Magazine, GEO, Der Spiegel, Newsweek, The Wall Street Journal, Paris Match, Guardian Review, D di Repubblica, L'Espresso, Internazionale, Io Donna, Vanity Fair, Monocle, IL, and many others. In 2011, he was awarded a grant by the Fund for Investigative Journalism for his long-term project on the tobacco industry. Rorandelli is based in Rome and is one of the founding members of the collective TerraProject.

Website: http://terraproject.net/photographers/rocco-rorandelli

Rocco Rorandelli
Rocco Rorandelli (Italy, 1973) started working as a documentary photographer after his studies in zoology, which helped him develop a profound interest in global social and environmental issues. His images have been utilized in several awareness campaigns of intergovernmental and non-governmental organizations, and published by the main international magazines, such as The New York Times, Le Monde Magazine, GEO, Der Spiegel, Newsweek, The Wall Street Journal, Paris Match, Guardian Review, D di Repubblica, L'Espresso, Internazionale, Io Donna, Vanity Fair, Monocle, IL, and many others. In 2011, he was awarded a grant by the Fund for Investigative Journalism for his long-term project on the tobacco industry. Rorandelli is based in Rome and is one of the founding members of the collective TerraProject.

Website: http://terraproject.net/photographers/rocco-rorandelli

Rocco Rorandelli
Rocco Rorandelli (Italy, 1973) started working as a documentary photographer after his studies in zoology, which helped him develop a profound interest in global social and environmental issues. His images have been utilized in several awareness campaigns of intergovernmental and non-governmental organizations, and published by the main international magazines, such as The New York Times, Le Monde Magazine, GEO, Der Spiegel, Newsweek, The Wall Street Journal, Paris Match, Guardian Review, D di Repubblica, L'Espresso, Internazionale, Io Donna, Vanity Fair, Monocle, IL, and many others. In 2011, he was awarded a grant by the Fund for Investigative Journalism for his long-term project on the tobacco industry. Rorandelli is based in Rome and is one of the founding members of the collective TerraProject.

Website: http://terraproject.net/photographers/rocco-rorandelli
TF Enhancing Human Security has worked in Southeast Europe’s (SEE) post-conflict countries since 1998. In states affected by the break-up of Yugoslavia such as Serbia, ITF works to support the country’s fulfillment of the Anti-Personnel Mine Ban Convention (APMBC), and this involvement has proved critical to Serbia fulfilling its goals.1

With a history of nationalistic antagonisms, a series of armed conflicts, secessions, and major political and state structural reforms stemming back to the turn of the 20th century, the history of the former Socialist Federal Republic of Yugoslavia (SFRY) and Serbia is a long and convoluted one, intertwined with religious and ethnic tensions.

Historical Context

After WWII, the territory of the Kingdom of Yugoslavia came under socialist rule, first as Federal People’s Republic of Yugoslavia, and then in 1963 as the SFRY, a socialist federation made up of the republics of Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia, and Slovenia. By the early 1990s, ethnic tensions dissolved into armed conflicts, as Croatia, Slovenia, the Republic of Macedonia, and Bosnia and Herzegovina seceded from the SFRY.2–3 In 1992, Serbia and Montenegro formed the Federal Republic of Yugoslavia (FRY), and later transformed into the state union of Serbia and Montenegro.4 Since 2006, Montenegro and Serbia are separate independent states.5

All six former republics have become independent states. However, many of these states, especially Bosnia and Herzegovina and Croatia, have some of the heaviest concentrations of landmines and unexploded ordnance (UXO) in the world. Serbia, which is contaminated with cluster munitions and continues to struggle with landmine contamination, is the focus of this article.6 Issues relating to humanitarian demining in Serbia are numerous, and progress toward a resolution of the mine problem largely depends on the provision of adequate donor funds.7–9

Cluster Munitions

During the 1999 bombing, the NATO alliance dropped cluster bombs in 16 municipalities in the Republic of Serbia, namely Niš, Kraljevo, Brus, Preševo, Bujanovac, Kuršumlija, Raška, Gadžin Han, Tutin, Sjenica, Čačak, Vladimirci, Knić, Stara Pazova, and Sopot.8–11

During and immediately after the bombing, the armed forces and police conducted clearance of unexploded cluster munitions from the surface, which substantially contributed to the safety of civilians and reduced the number of victims, specifically children. Numerous cluster munitions were deeply embedded in the ground and could not be initially detected, removed, or destroyed at the time, which is why surveys and clearance are presently needed to reduce the threat of explosive hazards for the local population.

Thus far, in accordance with the International Mine Action Standards (IMAS), 11.25 sq km (4.34 sq mi) has been checked and cleared in the municipalities of Niš, Sjenica, Gadžin Han, Stara Pazova, Knić, Brus, Raška, Kraljevo, Užice, Čačak, Vladimirci, Kraljevo, Sopot, and Preševo, while it is suspected that cluster munitions can still be still found in the 2.5 sq km (0.97 sq mi) area around various locations in the municipalities of Sjenica, Tutin, Raška, Bujanovac, and Niš.12–14 Many of the cluster munition clearance project tasks were
conducted in highly-populated urban areas, such as in the city of Niš (e.g., the primary school Dušan Radović, Niš city-hospital grounds, Duvanište city-residential area, and the city’s industrial zone), as well as in the Kopaonik National Park and Mountain Resort.15–17

**Mines**

During the 1990s, the Serbian Armed Forces placed landmines along the border with Croatia (Šid municipality, including Morović and Jamena). Even though there were no major military operations in this particular area, the minefields were placed for preventive purposes.

In accordance with the ITF mandate, a mine action unit from INTERSOS, an Italian NGO committed to assisting the victims of natural disasters and armed conflicts, carried out a broader assessment of the landmine/UXO problem in FRY in 2001. The assessment was collaborative and conducted with the FRY Federal Ministry of Defence, Ministry of Foreign Affairs, and the Ministry of the Interior of the Republic of Serbia.

After obtaining the relevant information, the Mine Action Centre of Serbia (MACS), in cooperation with ITF, organized a specific survey of the suspected hazardous areas (SHA) in the villages of Jamena, Morović, and Batrovci (Municipality of Šid), estimated to be 10 sq km (3.86 sq mi). Consequently it was established that minefields, which included both anti-personnel and anti-tank mines totaled an area of 5.9 sq km (2.28 sq mi).18 These areas were surveyed by MACS and cleared by demining companies through ITF between 2003 and 2009. There were a total of 44 project tasks, 5,139 various types of mines and other UXO were detected, removed, and destroyed.19,20 Along the borders with Bosnia and Herzegovina and Croatia, there are no more minefields on the Serbian side, and these areas are now safely used by the local population.21

**Post-clearance Effect on Demined Land in Šid**

Šid municipality consists of 18 large villages and towns with over 30,000 residents, including Morović village and Jamena village. This entire region of northwest Serbia is known for extremely fertile soil and high-quality forests, where mines directly obstructed agricultural development.20,22

The impact that minefield clearance had on this region was immediate. The agricultural land and forests were demined (declared mine free by MACS) and handed over to local communities for safe use. Mine clearance of this area offered great socio-economic potential for the region and its residents, which was hindered for many years due to mine fields.

**Ongoing Clearance**

In late 2009, the MACS obtained information about SHAs in the municipalities of Preševo, Bujanovac, and Kursumlija in south-central Serbia.23 A survey of the area was conducted from 2009 to 2011 by Norwegian People’s Aid through ITF, where it was established that at that time, there were 10 confirmed hazardous areas (CHA) in the municipalities of Bujanovac and Preševo, totaling approximately 3.5 sq km (1.35 sq mi).24–26

Since 2012, and with the support of ITF and its donors, these areas are progressively being demined and resurveyed. In 2018, with the
clear all mine-contaminated areas by 2014. Serbia later requested Serbia to destroy all anti-personnel mine stockpiles by 2008 and to countries for activities in Serbia including mine clearance, cluster training, and administrative assistance.

provided continuous support through technical equipment, vehicles, federal government of Serbia. Since the inception of MACS, ITF has the Federal Ministry of Foreign Affairs after a proposal by ITF to the consider accession until its stocks of cluster munitions are destroyed.31 has participated in several CCM meetings, it has stated that it cannot el, Serbia supports the CCM’s humanitarian objectives. While Serbia the Oslo Process that produced this convention. At the political lev-

Cluster Munitions and defined milestones.29,30 includes a substantive plan, thorough year-by-year operational goals, an extension of four years (until 1 March 2023). The extension request

On 30 November 2018, at the 17th Meeting of States Parties to the deadline, it submitted a second extension request on 14 March 2018. When it became clear that they also would not be able to meet the new deadline, it submitted a second extension request on 14 March 2018. On 30 November 2018, at the 17th Meeting of States Parties to the APMBC in Geneva, Switzerland, the Republic of Serbia was granted an extension of four years (until 1 March 2023). The extension request includes a substantive plan, thorough year-by-year operational goals, and defined milestones.39,30

Serbia did not sign and is not a State Party to the Convention on Cluster Munitions (CCM), even though it played an important role in the Oslo Process that produced this convention. At the political level, Serbia supports the CCM’s humanitarian objectives. While Serbia has participated in several CCM meetings, it has stated that it cannot consider accession until its stocks of cluster munitions are destroyed.31

Donors and ITF Support

The MACS was established in 2002 as an organizational unit of the Federal Ministry of Foreign Affairs after a proposal by ITF to the federal government of Serbia. Since the inception of MACS, ITF has provided continuous support through technical equipment, vehicles, training, and administrative assistance.

Since 2002, ITF has raised almost US$25 million from various countries for activities in Serbia including mine clearance, cluster munition clearance, battle area clearance, training, equipment, and structural support to national capacities (i.e., MACS). With generous donor support through ITF, over 13.65 sq km (5.27 sq mi) of land on 91 projection locations has been cleared and released, with almost 7,200 explosive items (mines, cluster munitions, UXO) removed.

Serbia remains committed to resolving the mine problem, continuously contributing its own funds for activities of mine clearance for the past three years.30

Post-clearance Effect

The impact of mine, cluster munition, and other UXO clearance in Serbia is always immediate. By clearing and declaring any type of previously-affected land as free of contamination, Serbia can hand over land to the local population for immediate use. Clearance of the contaminated areas unlocks great socio-economic potentials for the country’s regions and its residents.

Conclusion

Serbia’s experience highlights the importance of a collaborative, multinational approach to explosive hazards clearance. Despite the history of clashes and ethnic rivalry within and among the states of SEE, the impact of landmines, ERW, and UXO often crosses political and socio-economic lines and can contribute to regional destabilization. Ultimately, as Serbia continues to develop via socio-economic and infrastructural reforms, any portion of land that cannot be used safely is a wasted opportunity for local residents. To this end, ITF is determined to continue its work in SEE, coordinating mine action activities, victim assistance, and mine risk education projects with respect to national and regional goals. However, in order for Serbia to achieve APBMC obligations, continuous donor support is crucial. The mine action process is vital for all spheres of daily life as well as the local and national development strategy. See endnotes page 70

Gregor Sančanin

Head of Representative Office in Bosnia and Herzegovina
ITF Enhancing Human Security

Gregor Sančanin is head of the ITF Enhancing Human Security Representative Office in Bosnia and Herzegovina. From 2003 to 2011, Sančanin was the project manager for Albania, Montenegro, and Serbia at ITF. He holds a Bachelor of Arts degree in English and Literature from Faculty of Arts, University of Ljubljana-Slovenia. Prior to working in the humanitarian mine action sector he worked for seven years in the Slovenian news, media, and television sector.
Lessons from the Past:
Minefield Clearance and Casualties – Holland 1945
– Military Operational Research Unit Report No.7

by Roly Evans
[ Geneva International Centre for Humanitarian Demining ]

In June and July 1945, two Royal Canadian Engineer officers, on their own initiative, carried out a review of the ongoing minefield clearance in Holland. The local military authorities deemed the review to be of significant value and therefore directed the Military Operational Research Unit to take up the study and “carry out a complete survey and analysis of all aspects of minefield clearance and casualties.” The study, entitled Military Operational Research Unit Report No.7 – Minefield Clearance and Casualties, Holland 1945, was initially intended to gather lessons about minefield clearance casualties in relation to combat. It became a significant study of demining during peace time. The resulting fifty-seven page document remains one of the best analyses of minefield clearance, time, and resulting casualties ever conducted. Arguably, it has not been equaled or surpassed since. To this day, few in mine action are even aware of it.

Mine Clearance in the Netherlands

As in other liberated European countries, wide-ranging mine clearance in the Netherlands started remarkably quickly after the cessation of hostilities on 7 May 1945. Some limited clearance, mainly of routes, had taken place in southern Holland during the previous winter; however, concerted efforts only started when the occupying German 25th Army surrendered. By 20 May 1945, the Canadian and British military authorities, represented by the Allied 6th Army Headquarters, had overseen the formation of the German Draeger Brigade, named after its commander, Oberstleutnant (Lieutenant Colonel) Rudolf Draeger. The brigade’s 105 officers and 3,244 other ranks were formed from seven pioneer (engineer) battalions, a battalion of fortress troops already stationed in Holland and some other
assorted units. Notably, given the subsequent casualties, a German military hospital and staff at Bloemendaal, west of Amsterdam, was included within the organization of the brigade from the beginning. The Draeger Brigade would be responsible for the vast majority of mine clearance in the Netherlands. Of the 1,377,898 mines cleared by 23 November 1947, the Draeger Brigade had cleared 1,079,857 mines by as early as 31 December 1945. Some assistance was provided by the Netherland Mine Clearance and Bomb Disposal Company (BD) along with the 2nd Dogs Platoon, Royal Engineers (British Army). Dutch members of the Waffen SS imprisoned in a former concentration camp in Vught, near ’s-Hertogenbosch, given the opportunity of better treatment if they participated, were also involved in clearance in the south of Holland.

The Draeger Brigade established its headquarters in Delft, between Rotterdam and The Hague. Work concentrated on the northern half of the country until August 1945, with most effort focused on clearing the Atlantic Wall minefields on the coast. By October, all Draeger Brigade units had moved south of the river Maas to clear the minefields that resulted from the fighting between the Allies and the Germans. A replacement German military hospital at Sterksel, near Eindhoven, was placed under the Draeger Brigade’s responsibility at this time. On 1 October 1945, the Dutch Mijn Opruimings Dienst (Mine Clearance Service, MOD) took control of demining operations in Holland. Eventually approximately 1,800,000 landmines would be cleared in the Netherlands, some 422,102 cleared by the Dutch.

The Pioneer Battalions worked extremely fast, especially when compared with modern day clearance efforts. In part they were enabled to do this by the generally excellent minefield records kept by the 25th Army. One example is Minefield 235 Goldfisch, (renamed Minefield 20 in Dutch records) in The Hague. The minefield of nine hundred 270 mm artillery projectiles (Geschossminen), adapted to be mines by fitting T.Mi.Z.29 pressure fuzes (which had anti-personnel and anti-tank weight settings), was laid by the Pioneer Battalion of the 719th Infantry Division in five days during 18–22 April 1944. Covering an area of 87,688 sq m (104,874 sq yd) with a 194 m (212.2 yd) depth and 452 m (494.3 yd) frontage, it was cleared by a
Fallschirmjäger pioneer platoon in just two days, 26–27 July 1945. 7
Clearance of nearly 9 ha (22 ac) and nine-hundred mines in two days
would rightly not be repeated in modern mine action, where such a
task would take many months. Such speed underlines the urgency of
the task and the risks that members of the Draeger Brigade were ex-
pected to undertake. The location of this minefield today now forms
the playing fields of the International School in The Hague.

Collection and Quality Control of Data
One particular aspect of the demining operations in Holland was
the great emphasis placed on recording and checking data. Both the
official 6th Army Confidential Report and the Military Operational
Research Unit Report No.7 detail at length the procedures followed.
First, all minefield records were checked, assigned serial numbers,
and drawn onto linen map traces by a Royal Engineers Intelligence
Section attached to 66 Field Company Royal Engineers prior to clear-
ance. 8 A color-coding system to denote German or Allied mine-
fields was adopted: green for Allied, blue for German. Copies of all
maps were then bound in book form. An accompanying “Schedule
of Minefields” was developed, recording all known details to comple-
ment the maps. Records were duplicated into a field copy and a mas-
ter copy. Minefield maps were issued to clearance teams from June
1945 onwards. By 9 October 1945, 4,522 minefields had been regis-
tered in this way. Eventually 5,400 minefields and 900 areas contami-
nated with explosive remnants of war (ERW) would be registered in
Holland by 1947. 9 Ten book sets covered the whole of the Netherlands.

Further to this overview, individual minefield maps and the
remaining German records made up minefield files that were completed when
the clearance certificate was added. All documents moved under careful control
with the dispatch and receipt recorded in an index book. Importantly, field and
master copies were carefully compared at the end of the process for discrepancies or
irregularities as they were termed; essentially a form of data quality control not
always present in modern mine action. 10
For the period July–November 1945, time
spent clearing in minefields was also
carefully recorded in other forms with
comparisons between units and sites
made to check for irregularities. 11
6th Army HQ itself also recorded all
casualty data using a simple standard-
ized pro-forma split into a section detail-
ing the circumstances of an accident and
a section detailing injuries. Staff officers
sought casualty data wherever it could be
found, whether from unit medical offi-
cers, civilian doctors, or hospital records. Corroboration of forms was made by in-
terviewing witnesses and by examination
of the returned forms against unit dai-
ly records. 12 This careful and detailed approach to operational data,
very briefly outlined here, while unglamorous, was essential to the
subsequent operational analysis.
No study in mine action has ever recorded the man hours expended versus the mines removed on the scale of Military Operational Research Unit Report No.7. Trials were conducted of manual mine clearance methods in Moamba, Mozambique, from October to November 2004, and while the record of this is more detailed in some respects, it was a severely limited trial, not an analysis of a work sample as large as in Holland in 1945.

The study of "time and labor factors" in 1945 allowed an analysis for each battalion of the man hours expended per 100 mines lifted. This ranged from 57 to 78 hours—a difference of up to 27 percent between units, usually explained by the different concentration of mines between minefields rather than differences in operational efficiency. The more concentrated minefields required fewer man hours to remove an equivalent number of mines.13

The time spent removing different mine types was also calculated. Metal anti-tank Tellerminen required on average 56 man hours to remove 100 mines. Wooden, anti-personnel Schuminen, almost...
impossible to find with the detectors of the day, required on average 70 hours. The Riegelminen 43, required on average 97 man hours to remove 100 mines, most likely because deminers were extremely wary since wiring within the fuze mechanism could function easily on handling due to the effects of corrosion. In Holland in 1945, the Draeger Brigade removed, on average, a Tellerminen every 34 working minutes, and a Schuminen every 42 working minutes. The fastest time recorded in a given week for a minimum sample of 1,000 mines was 15 working minutes for a Tellerminen and 20 minutes for a Schuminen. Whether using the averages or the fastest times recorded, this speed of demining is well outside of modern norms, even in circumstances such as the dense minefield patterns in Sri Lanka.

Analysis of Mines Found

The Draeger Brigade’s conscientious reporting also allowed a good overview of explosive devices found. For example, careful records were kept of what mines were booby-trapped, what mines were assessed as being in a condition that made them unable to detonate and which mines had been damaged by the weather or corrosion. Less than 1 percent
of the main anti-tank mines, Tellerminen and Holzminen, were booby-trapped, 2.33 percent of S-Minen, and 2.97 percent of Riegelminen. This was less than the military authorities were expecting, having become used to German booby-trapping during the later years of the conflict.

Seven decades before the current studies of landmine aging, a relatively detailed analysis was made in Holland in 1945. Ground conditions were characterized into three categories: sandy/dry earth, low-lying meadows, and polder-land flooded since the mines were laid. The respective aging characteristics of casings, igniters, or fuzes and detonators for metal and wooden mines were noted in each of these conditions. The report found that wooden mines were unsurprisingly the most vulnerable to weathering, with 20 percent deemed damaged. Anti-handling devices, especially cocked striker pull fuzes, were particularly prone due to “damp penetrating the firing cap and rusting the spring.” Indeed, aside from what casing was used for the mine (metal being more resilient than wood), the chief cause of probable failure of a device was “the high percentage of ineffective igniters.” This is consistent with recent studies of mine functionality in the Falkland Islands, where of a sample of 100 P4B mine fuzes, only one was found to be functional.

Analysis of Accidents and Casualties

The Draeger Brigade sustained 563 casualties from 290 accidents in 1945, an average casualty rate of 17.5 percent of its final strength. There were 165 fatalities, 29 percent of all casualties. Casualty rates for its sub-units ranged from 6.1 to 29.6 percent.

The landmines or other explosive hazards involved in accidents were strictly recorded allowing an analysis of the respective risk of different mine types. Of the 563 casualties from 290 accidents, 391 casualties came from 201 anti-personnel mine accidents, 69 percent of each respective total. In terms of accidents proportional to mines lifted, bounding fragmentation S-Mines proved to have the highest fatality rate amongst anti-personnel mines. This corresponded to anecdotal experience of combat where soldiers routinely feared the S-Mine for the number of casualties it could cause over a relatively wide area. Even today bounding fragmentation mines tend to require enhanced safety distances during clearance operations. While there were significantly fewer anti-tank mine accidents (31 percent), when they did happen fatality rates were high as would be expected given the higher net explosive quantities involved. The mean number of casualties per accident ranged between 1.62 for the Schuminen to 2.32 for the S-mine, with an average for all types being 1.94. Safety or working distances were not introduced during these clearance operations, and it is difficult to understand why such a simple safety measure was not employed.
Units were given a high degree of discretion in how they went about clearing the minefields and considerable differences in procedure existed amongst them. The Battallion GROH, made up of former “fortress troops” manning the Atlantic Wall, stated that there were “never more than four men in any one mine-lifting party.” Whereas in Battallion 526, twenty men could be “prodding and lifting in the same row of mines.” The average size of mine clearance party working in close proximity to each other in the Draeger Brigade was seven other ranks and one NCO.28 Battalion 526 had the third highest casualty rate, Battalion GROH the lowest.29 Procedure was not the only explanation for casualty rates however, as the graph reproduced at Image 10 makes clear. In general the more mines a unit cleared the more casualties they had. As in modern mine action, explanations for given indicators could often be multi-faceted.

Schuminen were the most common mine of any type found in the Netherlands, with 229,431 cleared in 1945 alone.30 Despite some metal content, the mine was very difficult to find using the detectors of the day and effectively posed the same hazard to deminers as more modern minimal metal mines. Schuminen were normally detected using a standing prodding drill. This proved to be inappropriate and dangerous. Resulting injuries to the face and eyes from primary and secondary fragmentation were common, with rudimentary eye protection proving only partially effective. This prodding drill often missed Schuminen with casualties caused by stepping on them usually resulting in an amputation of the leg.

What was also significant about the Military Operational Research Unit Report No. 7 was how casualty data could be analyzed in context of the good quality operational reporting overall. For example, the study could calculate the number of mines lifted for each accident and for each casualty by battalion. The figures for the eight units ranged between the 20th Pioneer Battalion, who lifted 5,500 mines per accident and 2,720 mines per casualty (40 accidents), and the 346th Pioneer Battalion who lifted 1,240 mines per accident and 580 mines per casualty (49 accidents). For all the eight battalions there was a rank correlation of 0.71 between the number of mines lifted per accident and the number of casualties per accident.31 This could be explained by the differing working procedures in the field between units. However, there were other explanations. The 20th Pioneer Battalion tended to clear well-marked and recorded Atlantic Wall minefields; the 346th Pioneer Battalion was employed for a considerable time in the area of Arnhem clearing “unrecorded or scattered” Schuminen minefields. It is believed context such as this was important in understanding the difference in performance. As with all performance indicators, the key was to use the evidence as the starting point to seek further explanation. In short, the statistics allowed those in charge to ask the right questions. The same principle applies when using statistics and key performance indicators in mine action today.

The study also contained recommendations concerning the use of dogs in demining operations that resonate with experience in modern mine action. The requirements for practice on dummy minefield and the need for rest days in order to maintain the “interest of both dogs and men” were deemed essential. Handlers needed to demonstrate “care and patience.” While dogs had uses, they were deemed “not 100% effective.” It was decided that the dogs were not reliable enough to be used on known minefields but were better suited to “routine checking of suspect areas and the proving of and delimiting of areas in which mines were rumored to exist.” 155 miles of railway line, 73 miles under high tension cables, and 77,000 sq yd (64,382 sq m) were searched by “war dogs” with 29 mines being found in this way. Dogs were “fully justified on large areas of non-metallic anti-personnel mines.”32 Much of this experience is reflected in the modern Animal Detection Systems IMAS, where it is recognized that a concentration of explosive targets can confuse dogs, and the need for strict accreditation of both handler and mine detection dog is mandated.33

Conclusion

This brief summary of the Military Operational Research Unit Report No.7 has given only a limited overview. The detail the report was able to marshal is only partially reflected.

A number of German personnel continued clearance in Holland for another two years. The last 19 German Surrendered Enemy Personnel were sent back to the British Army of the Rhine for demobilization on the 3rd of October 1947. The final total of German casualties for both mine and ERW clearance in the Netherlands was 650. Of these 225 (34 percent) were fatal casualties. Eighty-three Dutch clearance personnel were also killed during the clearance effort of their country.34

Much was done poorly during the clearance efforts in Holland in 1945. Casualties were very high, unacceptably high by modern standards, and the treatment of German Surrendered Enemy Personnel remains contentious to this day. Clearance techniques were often rudimentary and safety precautions were often casual. Modern mine action has in many ways improved significantly on the technical demining ability of those who went before us in the post-war years, with better on-site procedures and personal protective equipment.

However, the limitations of the 1945 efforts should be seen in the context of what was done well, and even what was done better. The military authorities in Holland were ahead of their time in terms of analyzing their own operations, be it in relation to the use of mine detection dogs, aging of landmines, time studies, recording of devices found or the recording of casualties. Data collection and analysis was in many ways superior in 1945 than during much of modern mine action. Quality management of data in particular is an aspect where arguably we have still not caught up. We can do better. We owe it as a sector to the deminers risking their lives daily in the field to do so. See endnotes page 71

The author wishes to sincerely thank the following without whom this article would not have been possible. Antoon Meijers, Jan Wijdemans, Commander Eddy Jolink, Lt Col Hans Linschoten, WO Herwin Eric Bührmann, and Kit van den Anker.

Roly Evans
Geneva International Centre for Humanitarian Demining

Roly Evans is an Advisor in Land Release, Operational Efficiency and Training Development in the Operational Efficiency Division at the Geneva International Centre for Humanitarian Demining (GICHD). He also covers conventional Explosive Ordnance Disposal (EOD) including the Collaborative ORDNance data repository (CORD) and the development of the new Test and Evaluation Protocol 09.31. 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.
No one knows for sure how frequently accidents occur in humanitarian demining. This is partly because the details of accidents involving state employees are rarely shared, and national laws often restrict access to police or military reports. It is also because there is a frequent failure to comply with the reporting requirements described in the International Mine Action Standards (IMAS). IMAS 10.60 requires that “an accident in which a mine, ERW or explosives harms a demining employee, visitor, or member of the local population” shall be investigated and the report made available. However, although it is a requirement to share the results of investigations, it is currently not entirely clear with whom the results should be shared. Many accident reports were included in the Database of Demining Accidents (DDAS) between 1995 and 2011, but few have been shared recently.

Not having all the data means that it is not possible to provide a well-informed estimate of accident frequency. The only known study of accident frequency was conducted twenty years ago in Afghanistan, when all insurance records were made available along with all work schedules. The statistics on accident frequency presented in this article derive from the Afghanistan study; all other statistics discussed are from the DDAS.

The number of hours worked, number of deminers actually in the field, and the number of reported accidents and insurance claims were all made available. The results of the study indicated that we might expect one severely injurious accident per 32 field deminers every year. However, this ratio may be misleading. The working context, the explosive hazards present, and the equipment available all have an impact on accident frequency, quite apart from the quality of the training or the supervision at any worksite.
The data available to the Afghanistan study included all insurance claims, including those that were not related to explosive events. Perhaps surprisingly, there were more claims related to non-explosive events than there were for explosive-related injuries. The study also found that the consequences of all medical emergencies were sometimes profoundly affected by the level of medical and medevac provision that was available, a situation that has not changed.

IMAS 10.40 covers medical support to demining operations. It requires demining organizations to “be properly trained and equipped to respond to demining accidents,” but the medical support that it suggests is usually recommended, not required, because what can be reasonably achieved can depend on the context. Among the limited IMAS 10.40 requirements that IMAS compliant organizations must provide at each worksite are skilled medics, appropriate casualty transport, an efficient means of communication, and an accident response plan tailored for each worksite. A study of the DDAS accident records provides strong evidence that these are reasonable requirements.

Features that influence the outcome of an accident are not always causes of the accident. However, features can be things that make the consequences of the accident worse. An inadequate medical provision is noted in 14 percent of recorded accidents, but there are no records in which a trained medic gave inappropriate treatment. In some cases there was no trained or appropriately-equipped medic, in others, there was no ambulance vehicle, communications system, or medevac plan. In several, the casualty was taken to a medical facility that lacked the capacity to treat their injuries.

The Provision of Skilled Medics

Most of a field medic’s daily responsibilities involve providing mundane medications and first aid to the team, and sometimes to the community where they work. The rarity of demining accidents means that many medics have never seen a severe demining accident, so their ability to respond appropriately depends heavily on their training and experience prior to working in humanitarian mine action.

In Image 1, the field medic’s bag contains medicines that are fairly typical. Most are for everyday medical problems rather than injury because the medic often acts as the team doctor as well as a trauma paramedic. The drugs shown are common antibiotics, anti-flatulence drugs, and treatment for infected gums and anxiety disorders. A well-equipped medic will also have all the equipment necessary to respond to a traumatic injury.

Accidents in the working area are rare, so medics often spend many hours sitting and watching the other team members work each day. However, they have to be ready to react swiftly and professionally if an emergency occurs, and the DDAS accident records show that they have almost always done this well. Medics have been a casualty in almost two percent of all accidents recorded in the DDAS, and in four of these accidents the medic died. Six of these accidents involved other casualties who the injured medic was unable to treat.

To avoid risk to medics, some demining organizations require them to stay outside the working area while a casualty is brought to them. Other organizations allow the medic to go to the casualty as long as they always walk in safe areas. There appears to be no advantage in preventing the medic from going directly to the casualty, because most of the explosive-related accidents involving medics occurred in areas that were believed to be safe. To reduce the risks associated with the medic being accidentally incapacitated, some organizations employ skilled medical assistants and, following the IMAS, most organizations train all deminers in basic first aid.

Appropriate Casualty Transportation

Appropriate transportation is often a well-equipped ambulance, but certain contexts may require a boat or a helicopter. Whatever the vehicle, it must be available to transport a casualty without delay. While some injuries are obvious and treatment can begin in the field, other life-threatening trauma can only be diagnosed and treated after reaching a well-equipped medical facility. The medevac vehicle must also be appropriately fitted and equipped to carry the casualty securely, often over rough ground.
The demining ambulance shown on the left in Image 4 is obviously not a safe means of transporting casualties. By contrast, the demining ambulance shown on the right is adequately equipped, but only for one casualty. In over 12 percent of recorded demining accidents, there has been more than one casualty.

In insecure areas, some demining groups always send a back-up vehicle with an ambulance to provide assistance in case of trouble en route. Other demining organizations have used different approaches with the deminers’ transport vehicle also functioning as the ambulance. In one of these cases, a Land Rover being used as both transport vehicle and ambulance was carrying eight people when it was driven into the working area and parked on top of an anti-tank mine that had been missed during previous searches. The only means of communication was a radio that was destroyed in the explosion. There was no other vehicle, so no ambulance or medic. Two deminers died at the scene and two others died while being transported to hospital in a flat-bed truck and in four-wheel-drive vehicles owned by the public. Their unplanned journey took more than seven hours.¹

In another accident in which the ambulance was being used as a transport vehicle, it was travelling along a road believed safe when an anti-tank mine detonated under a rear wheel, and its long-range fuel tank caught fire.³ Three deminers died and seven were injured, including both medics, one of them severely. By chance, another demining group working nearby was able to send their medic and ambulance to help.

Image 4. The standard of ambulances used in demining varies from a mattress thrown into the back of a vehicle (left) to hygienic and well-equipped vehicle conversions (right).

Image 5. A converted vehicle capable of carrying two casualties.

Image 6. A well-equipped demining ambulance with space for only one incapacitated casualty.
As well as providing a dedicated vehicle, organizations should ensure ambulances are equipped to be as comfortable as possible for the casualty and to allow treatment to continue during transit. In another recorded accident, a severely injured casualty was safely loaded into the ambulance before the driver crashed into a tree as he turned the vehicle around. The impact threw an unsecured oxygen bottle across the back of the ambulance hitting the medic on the head, inflicting severe brain injuries.

A well-equipped ambulance with securely-fitted oxygen bottles like that shown in Image 6 cannot have the seating to safely transport a demining team and their equipment. The provision of a skilled medic and a single dedicated well-equipped ambulance may not be enough when there are multiple casualties. All demining organizations should be encouraged to practice medevac involving several simultaneous casualties so that the medics become familiar with the assessment and prioritization of multiple trauma injuries.

In another accident, the demining transport truck in Image 8 was carrying 25 people when it detonated a mine while driving to the worksite. Fortunately the organization’s ambulance vehicle was following behind. To ensure that there were no more mines, search and clearance were conducted at the same time as emergency treatment was given to eight injured people. The medic immediately made a radio request for assistance because there were too many casualties to be transported in the ambulance. Uninjured deminers reacted with self-discipline, searching for other mines while their colleagues were being stabilized, and a second ambulance arrived quickly. The team had practiced medevac procedures involving multiple casualties so they were well prepared to react professionally.

The accident record provides abundant evidence that a dedicated ambulance vehicle and medic are needed. There is also evidence that ambulances should not be used to transport deminers and should not be driven into the worksite. The record also provides evidence of the need for more than one means of communication at every worksite and a well-rehearsed medevac plan that covers the possibility of there being multiple casualties.

---

Image 7. A demining ambulance, after casualties were removed, that detonated an anti-tank mine with its rear left wheel while being used as a transport vehicle. 4

Image 8. A demining transport truck that detonated a landmine en route to the worksite.

Image 9. The picture shows deminers carrying a casualty down a mountain to the nearest road and the ambulance. 7
All Reasonable Effort

What is considered reasonable will often depend where the worksite is. If medevac starts far from maintained roads or the nearest viable hospital, it cannot be conducted at an ideal speed but, knowing that the work will be conducted remotely, other provisions can be enhanced to reduce the impact of any delay. The team’s medic(s) should have the necessary skills to diagnose, stabilize, and treat those in their care during lengthy transit and there must be enough medical equipment and consumables to meet all predictable needs. When it is known that alternative medics will not be readily available, trained medical assistants should always be available in case the medic becomes ill or is injured. Senior managers should maintain a detailed medevac exercise record and ensure that the provisions are optimized to prevent the medevac itself from making things worse for the casualty.

To comply with the IMAS, practiced medevac plans and proven communications systems must be in place, however remote the worksite, and coordination between all those who may be involved in an evacuation must be established before work in the hazardous area starts.

Whether by road, air, or river, medevac exercises should be conducted to give confidence that all reasonable effort has been made to recognize and overcome potential problems. Conducting medevac exercises should be a priority for new teams, or when starting work in new areas.

The Need to Share Accident Reports

For more information about the events surrounding the accidents mentioned in this article, please see the DDAS record number of each event as referenced in the endnotes. The DDAS is now a part of the demining Accident and Incident Database (AID) housed in James Madison University’s Global CWD Repository (https://commons.lib.jmu.edu/cisr-dda/). Its records provide many real-life examples in support of training and risk management. However, it is far from complete, which is unfortunate because the more detailed accident reports that it contains, the more use it can be. This article proves that even old reports can provide useful evidence of what works and what does not, so all accident and incident reports should be shared. Please send any accident and incident reports that you have for inclusion in AID to cisr-reporting@jmu.edu. Names and identifiers are always redacted so that no organization or individual suffers for sharing information that may help others avoid injury or death, and which supports the professional development of risk management in humanitarian demining.

See endnotes page 71

Andy Smith
AVS Mine Action Consultants
Website: www.nolandmines.com

A.V. Smith (AVS, Andy Smith) began working in humanitarian mine action (HMA) in 1995 in Mozambique. He has since worked in HMA in Afghanistan, Angola, Bosnia and Herzegovina, Cambodia, Croatia, Iraq, Jordan, Kosovo, Libya, Myanmar, Namibia, Palau, Tajikistan, and Zimbabwe. He was the founder of the Database of Demining Accidents (DDAS) and served on the International Mine Action Standards (IMAS) Review Board for 11 years. In addition to developing demining personal protective equipment (PPE), he has worked at all levels in HMA from surveyor/deminer to NGO program manager and Chief Technical Advisor to UNDP country programs and is currently a research associate at the University of Genoa.
Booby-traps are designed to entice victims to perform a physical action with an apparently harmless object that hides an explosive device that leads to the device’s unexpected initiation. Many booby-traps are improvised explosives devices (IED) and feature some kind of bait targeted to exploit emotions and the anticipated actions of security forces or civilians, who will initiate the explosive device in close proximity. Baiting is designed to attract attention and cause the victim to approach the IED. It is intended to pique curiosity or instinctual feelings, such as the desire to help (bait in the form of a body or an injured person), to profit (financial bait), longing (booby-trapped dolls used as bait in the Vietnam War), or those of honor and patriotism (using flags to lure soldiers to a device).

Many booby-traps feature some kind of bait designed to lure bomb disposal personnel closer to an IED and, in doing so, cause them to inadvertently step on a pressure plate. Other traps entice the victim to perform a physical action with an IED that will lead to its initiation, for example tampering with objects, such as flags or even weapons stockpiles abandoned by the enemy or competing forces. Anti-lift and anti-handling devices can also be improvised from other explosive devices and create a hidden danger for explosive ordnance disposal personnel. Such devices are often used in conjunction with anti-vehicle mines to prevent tampering with or removal of the mine.

On 17 February 2018, a booby-trapped Palestinian flag was planted along the Israel-Gaza border fence, east of the city of Khan Yunis. An Israeli Defense Forces (IDF) officer approached the flag to remove it from the border fence and was injured when it exploded as he laid it on the ground. The flag pole was booby-trapped with a victim-operated IED (VOIED), designed to initiate when the flag pole was tilted. The flag served as bait to draw in the victim (the IDF soldier).

Dozens of Palestinian flags are removed from the border fence on a daily basis without incident, causing the soldier to perceive this item as not dangerous, lowering the soldier’s mindfulness to the inherent dangers of these items that appear seemingly-harmless. Attempting to exploit mundane military or demining routines that invite complacency and reduce alertness among those who are being targeted for attack is a tactic utilized by terror organizations around the world. Using a weapon or ammunition as bait in a booby-trap is one of the simplest
traps to assemble. This tactic, technique, and procedure (TTP) is known the world over and is considered a “classic.”

On 28 September 2017, a Saudi Arabian soldier was reportedly wounded while neutralizing a mine planted by Houthi rebels near the southern border with Yemen. Video footage of the incident reveals the attempted neutralization and the moment the mine detonated. The documentation shows the Saudi soldier attempting to neutralize a TM-62 anti-tank mine. After unscrewing and removing the fuze, the soldier next raises the body of the mine, after which an explosion is heard. Upon closer examination, a lever can be discerned in the sand under the body of the mine.

The soldier raises the body of the mine, a distinct click is heard, and what looks like a lever can be discerned in the sand under the body of the mine.

Images courtesy of Terrogence.

The use of grenades as anti-handling devices is one of the simplest types of such devices taught around the world, used in the military in various improvisation situations and in instructional manuals produced and disseminated by terrorist organizations. In the jihadi arena, there are instructional videos showing how to extract the delay element from time delay fuzes for immediate detonation.

In April 2013, a jihadi forum member published a Lebanese Hezbollah instructional video on how to make a booby-trap or anti-handling device with grenades. The instructor demonstrates how to remove the grenade delay element, causing the grenade to explode immediately upon removal of the safety pin, without the usual three-to-four second delay. He then gives an example of how to use such a device to booby-trap a corpse.

Using hand grenades for anti-handling devices with mines was documented in a video circulated on jihadi forums in December 2012; the video depicted training exercises by a
group of Syrian rebels called the Mujahideen Brigade, a local contingent of the former Jabhat al-Nusra (JN) in the Latakia area of northwestern Syria. The video presents a practical lesson as well as hands-on practice in mine laying, where the instructor explains the components and operation of a Soviet-made PMN-1: a pressure-activated, anti-personnel landmine. In the video, a grenade is buried in a shallow pit, serving as an anti-lift device for the mine then placed on top of it.

On 8 August 2018, the Syrian rebel group Junud al-Sham published a video showing a training camp used by the group’s fighters. The video shows fighters training how to neutralize mines in the field. Additionally, one fighter demonstrates how to detect and neutralize a Claymore-type IED hidden in some bushes along a footpath, fitted with a pressure-release device in the form of a Russian-made grenade fuze with a tripwire tied to the safety ring and a grenade—with its safety pin removed—planted underneath the improvised mine.

As previously stated, there are jihadi instructional videos showing how to extract the delay element from time-delay fuzes for immediate detonation. However, even without removing the delay element, the surprise of hearing the faint pop of the exploding primer at start of the four-second delay period can catch a soldier or the targeted victim off guard, allowing sufficient time for the grenade or grenade fuze to detonate and cause the desired injury.

Explosive devices targeting bomb disposal experts are usually secondary systems that are hidden from view. In these cases, there may not be any discernible indication from the primary system that an additional system exists. In IEDs specifically designed to target bomb technicians, one or more components (the battery, telephone, or wires) is clearly visible in order to trick technicians into thinking that they have neutralized the initiation system or power source. Meanwhile, the secondary device is concealed, sometimes completely

Images courtesy of Terrogence.
Neutralizing mines.
*Images courtesy of Terrogence.*

Detecting and neutralizing the booby-trap (grenade) from under the Claymore mine.
*Images courtesy of Terрогence.*

Al-Karma, Iraq, January 2016.
*Images courtesy of Terrogence.*

Collection of fully-assembled IEDs comprising mines fitted with improvised pressure plates and anti-lift boxes, Falluja, Iraq, 2016.
*Image courtesy of Terrogence.*

Nineveh, Iraq, November 2016.
*Image courtesy of Terrogence.*
IS anti-tank mines, Al-Ramadi, Iraq, December 2016.
Images courtesy of Terrogence.

Anti-lift firing systems.
Images courtesy of Terrogence.

Anti-lift switches used by IS Sinai Province.
Images courtesy of Terrogence.

Anti-lift switches used by IS Sinai Province.
Images courtesy of Terrogence.

IS anti-tank mines, Al-Ramadi, Iraq, December 2016.
Image courtesy of Terrogence.
separated from the primary IED with an independent power source, while it actually constitutes an initiation system for both the primary and secondary device.

In June 2016, the beleaguered Iraqi city of Fallujah was finally liberated from the grip of the Islamic State (IS) after a month-long offensive. Workshops for the production of various IEDs, mortar rounds, rockets, and homemade explosives discovered in the city were extensively documented by Iraqi Security Forces and the media. Alongside fully-assembled IEDs comprising mines and improvised pressure plates were white boxes. The purpose of these boxes was to serve as anti-handling firing systems that would target deminers or bomb disposal personnel who would lift up the mine after first neutralizing the improvised pressure plate. Since then, these white anti-lift boxes and other anti-lift switches have been documented on many occasions and in different regions under the influence of IS.

IS has produced some mines with anti-handling features that are externally similar to their single-function, plastic anti-tank mines. These mines also have a similar interior to the improvised IS anti-tank mine, with a mechanical-pressure fuze located at the center of a concave metal plate inside the mine. Some of the mines also have a built-in pressure-release switch serving as an anti-handling device.

In order to avoid initiation by anti-lift switches and subsequent injury, deminers and bomb disposal personnel must always be alert to the possible presence of anti-lift devices and booby-traps when handling IEDs, mines, or any other ordnance or items that can be used as bait. Precautionary measures to prevent unnecessary exposure to anti-handling devices should be taken by counter-charging ordnance and mines by detonating the devices in situ, remotely pulling the device using a “hook and line” technique to negate anti-lift or tampering systems, or using penetrating technologies to inspect weapons or ammunition, which most commonly involve mobile X-ray systems to determine whether containers’ inner contents are legitimate or suspicious.

Michael Cardash
Senior C-IED Analyst
Terrogence

Chief Superintendent Michael Cardash, the former deputy head of the Israeli National Police Bomb Disposal Division, has served 27 years as a senior bomb technician. During those years he participated in numerous missions defeating IEDs and other counter-terrorist operations. He commanded bomb disposal units within the Israeli border guards and police during intense terrorist conflicts, gaining experience investigating, and responding to the variety of terror attacks including suicide bombing devices and incidents. Cardash currently researches global IED incidents, is the Senior C-IED Analyst at Terrogence, and authors the Terrogence Möbius C-IED reports, which analyze and assess global IED-related technical and tactical intelligence.
Collaborative Demining Training in Cambodia

by Jorge Rivero [U.S. Marines] and Tom Gersbeck [Oklahoma State University]

Since 2016, the Center for Fire and Explosives, Forensic Investigations, Training and Research at Oklahoma State University (OSU) has teamed up with Golden West Humanitarian Foundation to offer a training opportunity to military and civilian bomb experts, as well as OSU medical personnel and students. During the second half of January 2018, a group of civilian law enforcement bomb technicians, military explosive ordnance disposal (EOD) technicians, medical personnel, a lawyer, and educators visited Cambodia to participate in the OSU Explosives Ordnance seminar conducted by Golden West.

Throughout the seminar, numerous topics like exploitation, ordnance, explosives effects, medical treatment, and general demolition procedures were discussed and observed. Moreover, future technologies in the field of EOD training aids and field identification were presented to the group. The training consisted of an intense week of explosives seminars, life-saving techniques in a jungle environment, and an in-depth approach to large-scale inverting and explosive manipulation. While the days were long and jam-packed with information, the experience was incredibly valuable from an EOD technician perspective. This article will summarize the days’ events and lessons learned.

History and Additive Manufacturing

On Day one participants met Len Austin from Golden West Humanitarian Foundation who provided the group with a private tour of the Cambodian Mine Action Center (CMAC) Ordnance Museum. As a former United States Marine Corps Master Sergeant EOD technician with over ten years of mine-action experience working with Golden West in Cambodia, the South Pacific, Caribbean, and throughout Asia, Len was a valuable guide to explain the vast amounts of ordnance that the museum holds, where it came from, and how it was rendered safe. With so much experience and knowledge of the area and the types of ordnance used by the United States and other countries throughout Cambodia, Len both enriched the tour and engaged everyone in attendance.

Following the CMAC museum tour, Golden West took the group to its headquarters in Phnom Penh. Led by one of Golden West’s engineers, the group toured Golden West’s 3D Advanced Ordnance Teaching Materials (AOTM) manufacturing lab, where they create 100-percent, 200-percent, and 400-percent sized fuzes, landmines, submunitions, and other ordnance items. These accurate or oversized munitions function as training aids for anyone working in the fields of bomb disposal, demining, or public safety.

Toward the end of the day, participants traveled to one of the only remaining and most infamous Khmer Rouge prisons in Phnom Penh: the Tuol Sleng Genocide Museum, commonly known as the “S-21 Schoolhouse,” which was an eye-opening and somber experience. Participants were fortunate since one of the few survivors of the prison was there selling his book. Gunner Sergeant Rivero was lucky enough to speak with him and to see how vital telling the history of S-21 was to him.

Technical Overview and Manipulating Energetics

Day two began with a two-hour trip down a single-lane highway across southern Cambodia to the Kampong Chhnang Training Center (KCTC). There the group met Len who familiarized all attendees with the area and gave a safety brief. After a short lunch, Len gave participants a tour of the Golden West compound and the Explosives Harvesting System (EHS).

Len explained how the facility supports demining operations across Cambodia as well as CMAC. Following the briefing and demonstration of the facility, Len demonstrated each step in the EHS via stages. First, in the preparation area, which is located outside of the cutting house, Len described the numerous testing tools that the organization uses for testing friction, drop, and heat. On the display table, Len began to explain how all six projectiles present were cut and displayed. All six of the items were cut using different methods, so the purpose of the display was well founded.
Following this stage of the process, Len took the group to the cutting house in which a Russian-made 122 mm high-explosive (HE) projectile was being prepared for cutting. Len spoke about the different modules used in this process, the custom-made mounts, and where the machines are made and purchased. Throughout the tour, Len’s primary concern was safety, and he went into detail on the safety features for the whole operation.

Lastly, the group left the cutting area for the command center bunker in which the 122 mm projectile was cut remotely. After a short brief on the cut, the group made their way to the mixing house. In the mixing house, Len provided a short period of instruction on how heat is moved through a multi-layered housing, which results in a radiant heat melting and breaking the adhesion between the body of the ammunition and the explosive filler. Upon the explosives reaching their melting point, the explosives fall into the catch bin and are broken into golf-size balls before moving to the heating container. At this point, Len and his staff gave the group a detailed briefing on different explosives used, quality control, and what he and his team look for when melting the explosives. Upon completion of this step, the melted explosives are poured into a high-heat silicone form, which makes their 100 gr boosters that the team uses to destroy mines and other unexploded ordnance (UXO).

**Technical Approaches to Success**

**Day three** began with a short briefing by Len, who then led the group to Golden West’s “Elephant Range.” Eight separate shots—or detonations—were scheduled, with each shot having an ordnance item to be destroyed. Each shot was briefed by Golden West staff and primed by its team while the students were all accounted for at the bunker.

**Shot one.** 1,000 U.S.-made 20 mm HE projectiles were destroyed with the use of Golden West’s NMD liquid explosive. This shot was one of the most educational. Experienced EOD technicians conduct shots with thousands of pounds of net explosive weight (NEW). Using bulk explosives like C4 on these vast shots causes kick-outs of munition debris more often than not. For EOD techs doing large-scale demolition operations, kickouts are becoming an even bigger issue due to the U.S. moving toward insensitive high explosives. However, Golden West uses liquid explosive, and the results of these shots are astonishing. The liquid explosive allows for much greater HE-to-HE contact throughout the process, which significantly reduces the probability of kick-outs and therefore reduces the
The 1,000 20 mm HE Projectiles that Austin used on his liquid explosives shot.

Exit hole in 40-mm thick steel plate from the 35-ml NMD shaped charge.

The chances of having ordnance scattered through a demolition area. With plastic explosives like C4, HE-to-HE contact can be achieved on some or most parts of the ordnance item but not all.

**Shot two.** Five Chinese 60 mm HE mortars were filled with dinitronaphthalene (DNN) explosives using liquid explosives for the detonation. This shot was significant in showing once again the power of liquid explosives to dispose of DNN, which is known to be an incredibly insensitive munition that offers substantial problems during the disposal phase of EOD operations.

**Shot three.** One Russian-made TM-46 anti-tank landmine containing 5.7 kg of TNT. For this shot, the 100 gr EHS booster was used to demonstrate the effectiveness of the explosives.

**Shot four.** One Russian-made 122 mm artillery projectile containing HE was detonated. During this shot, another 100 gr EHS booster was used to demonstrate its ability to penetrate a ½-inch thick plate of steel.

**Shot five.** One Chinese-made 120 mm mortar containing HE was used. For this, a 35 gr SEA-91 was used. SEA-91 is a homemade pliable explosive made via the EHS. This shot was once again done to demonstrate the ability of these EHS products.

**Shot six.** One U.S.-made 105 mm white phosphorous (WP) projectile was used. Another SEA-91 tool was placed in the fuze well to demonstrate destroying WP-filled munitions, which are extremely dangerous for EOD technicians.

**Shots seven and eight.** These shots consisted of 40 mm thick steel plates placed on the ground, hit with two shots. The shots demonstrated the effectiveness of the explosives made at the EHS. For the first shot, a 100 gr EHS booster was placed touching the plate and detonated creating the spalling...
effect on the plate. The second shot used 35 gr of liquid NMD in a container positioned with a standoff of 75 mm and detonated. The precision and penetration of these two charges impressed everyone in attendance.

After lunch, Golden West’s Dr. Marcel Durocher provided classes on geology, surface and subsurface search, and mapping techniques. Dr. Durocher also provided instruction on eight different types of equipment used throughout the demining community.

Interconnections Between Victims, Bomb Disposal, and Medical Personnel

Day four began with a safety briefing from Len and movement to the Elephant Range. The demonstrations involved two 80-lb pigs due to the close resemblance with the human body and ease of acquisition; both pigs were euthanized roughly one hour before shots occurred. Having a medical doctor and 4th-year medical student within the group, the training capitalized on the opportunity to analyze the effects of these ordnance items, as the medical personnel expertly detailed the external and internal injuries suffered. Three shots were planned in which two would involve the pigs, and the third was a quality control shot of the new batch of EHS boosters. All students remained in the downrange safety bunkers while the shots were prepared.

Shot one. The first pig was in a standing position with its rear legs touching the ground and wearing military-style boots. A Russian-made PMN-1 anti-personnel blast mine was positioned underground beneath the pig’s rear right foot.

After detonation, Len sent Golden West’s drone downrange to ensure it was safe for personnel. Upon arriving on site, we saw the pig on the ground with wounds consistent with mortal injuries. Once all students were present, Karley Koch, a 4th-year medical student at OSU, dissected and provided details on the pig’s injuries, severity, and survivability of those injuries.

Shot two. The second pig was secured between two small trees at a 45-degree angle with a sheet of plywood to its left. A Russian-made POMZ fragmentation mine was positioned one meter from the pig and 1 ft (0.3 m) off the ground. After detonation, the pig was laid on the ground and split open. Koch again examined and dissected the pig. While narrating the results, Koch provided first-hand knowledge of the injuries and probability of survival of a human being, concentrating on a child weighing approximately 75 lbs.

Shot three. The EHS charges were all chosen randomly from the lot, transferred to the range and detonated on steel plates. For the lot to pass certification, all three of the shots must penetrate the plates, which all three did.

Conclusion

For those in attendance of OSU and Golden West’s collaborative training opportunity, the experience taught valuable lessons that participants took back to their respective fields. For those in attendance, the experience was one-of-a-kind. It is the authors’ hope that Golden West can host additional courses so that other military members, civilian bomb squads, and medical personnel also can benefit. The world we live in, which is full of unpredictable regimes, volatile situations, and terrorist groups, only leads one to understanding the need for well-educated and trained people who are willing to help those trying to survive in formerly- and currently-contested areas contaminated with mines and UXO. In 2020, OSU and Golden West will be hosting another training course February 24–28. For more information, please contact Tom Gersbeck at tom.gersbeck@okstate.edu.

Jorge Rivero

Jorge Rivero is an active duty Marine EOD technician. Rivero joined the EOD field in 2011 after multiple infantry deployments to Iraq, Haiti, and the Middle East. After graduating from Naval School Explosive Ordnance Disposal (NAVSCEOD), he deployed to Afghanistan in 2013 and to Europe and Africa in 2015 where he served at Second EOD Company as a Team Member and EOD Team Leader. Rivero holds a Bachelor of Arts in Political Science from Arizona State University and is currently enrolled in George Washington University’s master’s program.

Tom Gersbeck

Tom Gersbeck is a retired Marine EOD Officer, and has been an International Association of Bomb Technicians and Investigators (IABTI) member since 1991. Currently, Gersbeck is the Military Liaison and in the Oklahoma State Center for Improvised Explosives or IMPEX in the school of Forensic Science. He continues his work as a training coordinator for the Golden West Humanitarian Foundation.
Drones in the Desert: Augmenting HMA and Socio-Economic Activities in Chad

by John Fardoulis [Mobility Robotics], Xavier Depreytere, Emmanuel Sauvage, and Pierre Gallien [Humanity & Inclusion (HI)]

Figure 1. The team approaches a minefield for the first consumer drone cartography flight over a confirmed hazardous area (CHA) in Chad. All images courtesy of the authors.

Funded by the Belgian Directorate-General for Development and led by Humanity & Inclusion (HI) under the auspices of the National Mine Action Centre, Haut Commissariat National au Déminage (HCND) in Chad, the Odyssey2025 Project explores ways to accelerate land release for the local population with the combined use of small drones, new survey methods, and mobile data collection. Project partners include Mobility Robotics, Dynergie, InZentive, and Third Element Aviation. A practical, field-driven approach is being undertaken together with partners in the PRODECO project, (MAG) Mines Advisory Group, and Fondation Suisse de Déminage (FSD).

Online literature is available that discusses the pros and cons of different types of drone airframes, and how the mapping process takes place. A good starting point for further reading is the FSD Drone Portal: www.drones.fsd.ch; Geneva International Centre for Humanitarian Demining’s (GICHD) recently launched e-learning portal: https://gichd.litmos.com, which provides information about how to integrate drones into humanitarian mine action (HMA); and the articles featured within The Journal of Conventional Weapons Destruction on the use of drones in HMA.1–8

On 24 January 2019, the authors created the first drone cartography of a minefield near the village of Amoul, in the Faya-Largeau area of northern Chad. The goal of this first mission was to validate how drones can provide better situational awareness of suspected hazardous areas (SHA), confirmed hazardous areas (CHA), and zones clear of contamination in desert conditions. This campaign is part of a broader trial to determine how small drones can help to accelerate the land release process and gain operational efficiencies. The next stages include assessing the effectiveness of drone data to tighten the definition of SHA/CHA borders, indicate where land might be cancelled or reduced, and achieve more targeted technical survey. Other practical benefits will also be explored by combining drone and HMA expertise during embedded field trials.

MATERIALS AND METHODS

SMALL UNMANNED AERIAL SYSTEMS

Where possible, the authors have tried to leverage the data capture potential from relatively low-cost, commercial off-the-shelf (COTS) drones. The concept of operations presented here takes COTS equipment and software, and combines known processes and defined indicators to generate actionable operational intelligence. Rather than try to reinvent the wheel, these tests strive to get better mileage from existing equipment and software that is already accessible to the community.

A starting point was using indicators of direct evidence listed in 07.11(5.3) Land Release of the International Mine Action Standards, with signs of contamination including visual observation of explosive ordnance (EO) parts, craters, detonations by animals, mine signs, fencing, EO accidents, or incidents where the location of the event could be accurately determined. Initial indicators of an absence of contamination include roads in use, land used for certain types of agriculture, and footprints from large animals. Work is ongoing with HI technical staff, and the national mine action center (MAC) to validate further direct and indirect indicators. The January mission trialed new equipment such as the first sub-1 kilogram drone with variable optical zoom: the DJI Mavic 2 Zoom (M2Z).9 Video goggles were also tested, to determine how useful a more immersive live experience would be during inspection and reconnaissance operations. For example, an explosive ordnance disposal (EOD) specialist might want to direct the pilot to fly closer to or around...
staff as high-resolution, offline, Google Earth layers—making GIS data viewable on every laptop, prompting discussions regarding how to prioritize the deployment of technical survey assets.

**MISSION PLANNING**

Two modes of operation were used:

- Relatively low-altitude inspection flights, remaining stationary at times to hover, circle, and zoom, capturing snapshots of evidence points during inspection and reconnaissance missions.
- Programming mapping missions to automate data capture in a set way to generate cartography and topographic information.

During the first trial, the purpose of drone inspection missions was for planning to gather evidence for EOD specialists to make judgments regarding the cause of explosions at accident locations and discuss the probability of nearby hazards. Mapping missions were used to create an area overview of the entire CHA, looking for patterns and to function as a base map for operational planning.

**HUMAN INTELLIGENCE**

Human intelligence from mine action specialists is just as important as an ambitious data-capture strategy and can provide answers to “so what” questions regarding features identified in cartography and inspection data. For example, identifying a pattern of recent tire tracks across a CHA can impact operations in different ways, depending on interpretation. Tire tracks indicate that members of the public are driving through the CHA, which might signal a need to better mark the perimeter with warning signs, or conduct mine risk education (MRE) in the area, perhaps elevating the priority of technical survey or clearance of that site to prevent accidents. Or perhaps tire tracks hint that a portion of the polygon is clear of contamination because an explosion did not occur when a vehicle drove through, suggesting an adjustment of CHA borders. This example also provides insight into how drone data can influence different aspects of HMA activities ranging from MRE to clearance. Collaborative research will continue during the length of the one-year project, determining which features are most useful and documenting outcomes under field conditions.

**GROUND SIGN INDICATORS**

The true value of drone data will be determined by how it can augment operations on the ground: capturing evidence-points, features of interest, patterns, man-made anomalies, or other clues that provide hints of what might (or might not) be under the ground. Moreover, by providing a better understanding of the terrain, drones can help identify hazards, access points, or elements that might pose challenges for operations.

In some cases, it will be beneficial to re-survey a SHA or CHA to gain additional knowledge such as patterns not visible from a ground-level perspective, helping target technical survey or clearance assets by directing them to hot spots first. In other cases, EOD specialists might deem that CHA borders can be redefined. Working closely with the chief of ops and technical field managers (TFM) is important to align strategies with the end users of drone data products.

Hence, a key objective during the first mission was to collaboratively develop a catalogue of ground-sign indicators and prove how using cues from the catalogue can influence operations on the ground. Creating a framework for generating valuable, actionable intelligence is central to process innovation.

**TEST LOCATIONS**

Field tests took place in three locations, providing a mix of terrain, ground signs, and objects to inspect or map. The first site was a minefield (Figure 4 and Figure 5) where demining teams were conducting technical survey in a CHA. The second CHA location (Figure 3) was a battle area clearance site where a destroyed vehicle was carrying 122 mm

---

**DATA PROCESSING**

Images from mapping flights were processed with COTS photogrammetry software to create orthomosaic, topographic, and digital surface model (DSM) outputs. Data outputs were analyzed and post-processed in geographic information system (GIS) software using ESRI’s ArcMap application. Data sets were also provided to HI and MAC technical

---

**SOFTWARE AND APPS**

The cartography flight-planning process involved importing a SHA or CHA polygon from the MAC Information Management for Mine Action (IMMSA) database into a drone autopilot app before leaving for the field. Each MAC has a database of SHA or CHA points and polygons, collected years or decades prior. If a polygon does not exist, a flight plan covering a greater footprint than the area of interest will be programmed. Three different flight-planning apps were tested. Poor internet connectivity was a particular challenge while working in the desert, and the plan needed to account for that.

---

**TEST LOCATIONS**

Field tests took place in three locations, providing a mix of terrain, ground signs, and objects to inspect or map. The first site was a minefield (Figure 4 and Figure 5) where demining teams were conducting technical survey in a CHA. The second CHA location (Figure 3) was a battle area clearance site where a destroyed vehicle was carrying 122 mm
rockets. Imagery from these two post-conflict sites will be added to a ground-sign database to calibrate against in the future. The third test site (Figure 9) was a training location for HI’s GCS-250 demining machine to create slope maps for planning mechanical operations.16

RESULTS

GROUND-SIGN INDICATORS

In Figure 4, Images 1 and 2 show how overhead photos of ground signs can be captured by an operator standing 200 meters away, outside of the CHA. Image 1 is evidence of a camel accident, with a vehicle blast crater next to it, and possibly a second crater under the animal bones. Image 2 is evidence of a vehicle accident, with the blast area possibly under the left front wheel.

Image 3 shows how cartography can help to join the dots between Image 1 and Image 2. If you draw a line in Image 3 between the two accidents, it appears that they occurred along an old road. A pattern is visible on the ground, which may be weathered signs of its presence. Piecing all the information together suggests that the road may have been mined because of its strategic nature during the conflict. Or perhaps this man-made pattern relates more directly to the conflict, or subsequent post-conflict operations? Whatever the case, based on imagery analysis, more targeted technical survey is required in that area.

Tests showed how inspection flights can distinguish fine details from different perspectives for a bigger picture, with cartography capturing the whole polygon (Figure 5) to look for patterns.

The crater next to the animal accident in Figure 4, Image 3 is visible from a higher (cartography) flying altitude, but individual bones are difficult to see from that height. Figure 4 demonstrates how a combination of imagery from inspection and cartography flights can complement each other. Personnel can also return and inspect hot spots more closely if technical advisors want more information.

EVIDENCE-BASED SURVEY

These results provide field examples of how high-resolution imagery and cartography can assist the HMA process. A starting point was resurveying CHAs currently being worked on by ground teams to identify indicators and ground truth data, calibrate resolution, quality-check mapping capabilities of a sub-1 kilogram drone, and gain validation from EOD personnel. The data also shows how several different observations can be linked together, which can increase confidence levels for decision making.

SPEED

It only took a few hours on-site to capture all the raw data regarding the minefield, proving how fast reconnaissance and cartography data capture can be compared to opening technical survey lanes to examine hot spots. After the raw data was captured, cartography took about a day to process per site back at the base.

MORE TECHNICAL INSPECTIONS

Being able to move a camera in three-dimensional space and capture imagery from directly above means scope for more technical interpretations of data. From the drone data, the authors determined that the size of the crater next to the animal bones in Figure 4 Image 1 to be 2.15 meters in diameter. Such information can affect planning by indicating whether the explosion was from an anti-personnel or anti-tank mine.

HIGH-RESOLUTION TERRAIN MAPPING

Mapping terrain and other elements of the natural environment can help many aspects of HMA operations. However, the process of creating maps from drone data is more involved than the process for inspections. Thus, field validation in-country was important, e.g., proving that it was viable to map sand dunes. Figure 6 shows the results of a sand dune mapping test, with Image 1 being a high-resolution orthomosaic map that shows how sand dunes can be recognized visually. Image 3 of Figure 7 shows how a topographic map was created by post-processing a DSM from drone data. Although it was initially unclear, the reflectivity and texture of sand did not make a difference, and standard techniques were fine. Mapping sand dunes is of interest as they tend to move, affecting access to sites by covering/uncovering contamination.

The ability to map roads was also field-proven, which will be useful because demining roads is a priority in many locations.

The usefulness of being able to spot rocky outcrops, unfavorable terrain, and other hazards for demining machines was validated, in association with the mechanical operations team (Figure 3 and Figure 9). Data was captured (Figure 9) to help plan how the drone and demining machine can work together. Figure 9 shows a slope map, indicating different terrain inclines at the machine training site (top right, green area).

The idea was to identify locations where the demining machine can excel, and map out hazards in advance, so that the amount of time and money...
spent on repairs are reduced. There are many ideas to field test across multidisciplinary teams next mission.

**QUALITY OF MICRO DRONE ZOOM**

Results of variable optical zoom tests from the M2Z were positive, with sample data from 25 meter and 119 meter heights shown in Figure 7 and Figure 8.

Original photos from the drone are shown in Figure 7 Images 1 and 3, and in Figure 8 Images 5 and 7. Differences that the two times zoom makes in object detail and image footprint can be seen in columns on the left.

Sections of each photo were reviewed at very high magnification on a PC to compare fine details. For example, a difference in sharpness can be seen along the edges of the rocket body and in the details of the human footprints when comparing Figure 7 Images 2 and 4 at a 25-meter height. Improvements in detail and sharpness are also visible when comparing the zoom to standard perspective in Figure 8 Images 6 and 8 at a 119-meter height.

Testing also took place to review the quality of an additional variable two times digital zoom (total four times) in high-definition (HD) video mode, i.e., the ability to zoom from 24 millimeters to 96 millimeters (equivalents). The quality was acceptable, and helped capture more detail without having to fly closer.

One of the key findings was that up to four times variable zoom in HD video mode (two times for photos) was easy to operate while flying. The operator can adjust the zoom by moving a wheel on the controller, providing greater utility than other drones in that class. The option to capture a more tailored perspective while in flight will simplify workflow back at the base, negating the need for post-processing analysis of features of interest.

The outcome from these tests was to validate that the M2Z as an effective tool with additional inspection capabilities.

**VIDEO GOGGLES**

Glare can be an issue in the desert, so enclosing an observer’s view and placing the display close to his/her eyes means a more immersive experience, with much greater magnification. Several EOD specialists tried the video goggles as part of a combined drone/EOD team scenario, and feedback was positive. One of the best tests will be during EOD spot tasks next mission. A more immersive, live experience will allow a specialist observer to inspect evidence of hazards from a safe distance and better assess a site in real time. Gaining a high-quality camera view, moving in three-dimensional space, flying around objects, viewing from different perspectives/angles ranging from up-close inspection to a broad footprint of the area from a higher altitude, which will help save time. Searching a broader area around the perimeter is often faster from in the air than on the ground. CHAs can be several hours drive from the base, meaning that becoming more productive per visit will improve efficiency.

The video goggles also proved to be a useful educational tool, allowing deminers to gain a birds-eye perspective, as if they were flying inside the drone. Dozens of people got to try.

For more information about results from the January field mission, including flying videos and sample data see: www.mr-au.com/chad.
Figure 7. Two photos taken from the M2Z at a height of 25 meters: Images 1 and 3. Image 1 is at a standard wide-angle perspective. Image 3 was taken at the same height but used the two times optical zoom. Image 1 and 3 show the differences between the area captured and enlarging features of interest. Image (2) is a magnified version of the standard perspective to compare fine detail on a computer. Image 4 is the optical zoom photo, magnified on a computer. You can see differences in quality in the magnified images, particularly the edges of the rocket casing and detail in human footprints.

Figure 8. Two photos, Images 5 and 7 taken at a height of 119 meters using the same methodology as above. Differences in the rocket casing can be seen in Images 6 and 8, plus clearer lines and sharper edges in the vehicle remains in Image 8.
LESSONS LEARNED

The ability of small consumer quadcopter drones to remain stationary by hovering presents a lot of potential opportunities for inspections and reconnaissance, particularly when a zoom camera is included. In addition to traditional HMA tasks, micro models have the added value of being well-suited for inspections of damaged buildings in Iraq, Syria, and Libya, as they are used increasingly during IEDD operations, looking for small objects, such as wires. Examples of inspections are shown in Figure 4 and Figure 7.

Most drones have a wide-angle lens as standard, which is often better for mapping flights. However, as the M2Z illustrated, the flexibility to zoom produced both acceptable mapping quality and offered improved results for inspection and reconnaissance. A minimum standoff distance from the ground, obstructions or possible hazards will need to be specified in drone standard operating procedures, meaning that zoom capabilities from an altitude or standoff distance of 15–30 meters will be useful. Being able to dynamically zoom using the M2Z is practical and comes at virtually no extra cost. An additional element that the authors will monitor is heat dissipation, as the electronics seemed to heat up more while in operation than slightly larger drone alternatives. There are restrictions regarding the size of drones allowed to be used in HMA operations in some countries. Being a micro size, the sub-1 kilogram model fits within such restrictions.

A lessoned learned relating to Figure 4, was that a drone is a fast reconnaissance tool, compared to otherwise having to open technical survey lanes for inspecting suspected hot spots; i.e., flying in from outside the CHA to capture evidence points. This doesn’t negate the need for human assets on the ground but could help to gain better efficiency from more targeted technical survey. Another lesson learned was the power of being able to digitize site information (Figure 5). This led to greater collaboration, with inspection data and cartography reviewed simultaneously; by TFMs, the chief of operations and the regional technical advisor.

Results from the first field campaign suggest that progress can be made in innovating processes, gaining synergy by blending HMA and drone expertise to collaboratively find ways of making an impact. The equipment and software used for this project were purely COTS, meaning that it’s all about applied usage and know-how.

A few operational questions arose along the way, such as the policy regarding wearing personal protective equipment (PPE) while operating near SHAs or CHAs. Project members determined that it is up to the site manager (e.g., a TFM) to have the last say where and when PPE needs to be worn.

LAND-RELEASE

One of the foundations of land release is the non-intrusive gathering and checking of as much evidence as possible, with drones being an asset to help leverage or augment the value of other assets by providing additional site-specific data. Drones will not replace deminers on the ground in the foreseeable future, and they won’t replace human intelligence. What they can do is provide additional targeted information to help gain better productivity from human, mechanical, and animal assets.

Decisions regarding each site need to be made on a case-by-case basis; however, gaining confidence in indicators that better pinpoint evidence will help target technical surveys and clearance, perhaps starting from hot spots and working outward. Ideally, discussions regarding fade out from hot spots inside CHAs might lead to new ideas regarding targeted technical survey that saves time and resources. Gaining confidence in indicators that suggest the absence of contamination, most likely combined with other information could lead to an acceleration in the amount of land being cancelled or reduced. Decisions need to be risk and evidence-based, combining data from various sources, and include both ground and aerial assets, as an area may not be deemed hazard-free purely based on no visible signs.

HUMANS IN HMA

Removing explosive hazards is important, but the process of doing so can be slow and expensive. Being embedded in remote demining operations meant ties to the community. Meeting local villagers and representatives from the regional government helped teach project members about the needs of the local population, who are the actual beneficiaries of HMA work. What do they believe is most important? The road or shortcuts linking the north to N’Djamena?

BEYOND RESEARCH

Even though there are research components, the scope of this project extends further because an operational framework for drone usage needs to be implemented. Together with the HCND, HI and Mobility Robotics are launching humanitarian drone operations in Chad for the first time. There are no formal regulations regarding drone usage, meaning that approvals are required from multiple ministries/authorities, including the Ministry of Defense and Aviation Authority. Importing equipment can be a challenge, and delays in customs clearance are not uncommon.

Building capacity by training pilots is another goal, as recruiting the right candidates improves sustainability once the Odyssey2025 project...
concludes. Dront equipment has been selected to provide local teams with field kits that are fit for purpose. Information technology equipment is being procured, including powerful laptop computers, a desktop processing workstation, and archival-storage system to handle the large volume of data generated. These must be located at the base in northern Chad, as self-sufficiency is required due to poor internet connectivity. Workshops will be held for government ministries and other humanitarian organizations in Chad to prompt thoughts regarding drone potential in other areas.

Logistics are also important. For safety, a minimum of two vehicles must travel together when venturing into the Sahara Desert, with a medic often required as a precaution. If multiple drone teams are deploying simultaneously to five locations, they require ten off-road vehicles, 10 drivers, five medics, five pilots, five observers, and sharing the resource of a technical specialist, such as a TFM. Such elements may affect the scalability of drone operations.

CONCLUSIONS AND FUTURE WORK

Results from the desert field trial helped to establish proof that, when tailored effectively, imagery can help augment other assets and suggest ways to gain operational efficiencies. Two modes of operation were established: inspection and cartography. Work will continue to increase the depth and breadth of the ground-sign catalogue, and field test the validity of each indicator.

Time and resources permitting, a satellite data study may take place, conducting a trade-off analysis using drone data for calibration to ground-truth space data.

During the next two field campaigns, a number of different categories of drones and sensors will be tested in a desert environment, with capabilities matched to mission objectives.

Ideally, enough sample data sets will be captured from in the field to use as a proof of concept for future initiatives utilizing artificial intelligence, deep learning and machine vision techniques for automated analysis. Lessons learned will be shared through in-depth case studies.

Capacity-building will commence during the next mission, providing equipment, teaching Chadian pilots how to operate drones and about the processes required to convert data into actionable intelligence.

ACKNOWLEDGEMENTS

The authors would like to thank the donor, the Belgian Directorate-General Development for making the project possible. Special thanks are in order to the people of the HCND for their support and for making pre-testing a reality. The GICHD and FSD deserve thanks for joining the technical steering committee for the Odyssey2025 Project. We’d like to thank the following people for their contributions and assistance: Seydou Gaye, Victoria Memel, Jason Mudungay, Gary Toombs, HI staff in Belgium, Lyon and Chad, and the MAG, FSD and OCHA teams in Chad. Feedback from reviewers is appreciated. The University of Bristol deserves thanks for providing access to software and super-computing resources.

See endnotes page 71
Ukraine’s Newly Adopted Mine Action Law: What Does This Mean for MA Programs? by Garbino | from page 13 |

2. According to the Protection Cluster and based on the Danish Demining Group (DDG)’s assessments, the number of mine and ERW victims is approximately 1,600. The Landmine & Cluster Munition Monitor, however, places the figures as high as 3,600 (Landmine & Cluster Munition Monitor, Ukraine Casualties Report (2017)). Geneva, Switzerland: International Campaign to Ban Landmines – Cluster Munition Coalition, 2017.
5. According to the Head of the Coordinating Group for Mine Action, the main national mine action operators are the Armed Forces of Ukraine (AFU), the State Special Transport Service (SSTS), now under control of the Ministry of Defense, and the State Emergencies Services of Ukraine. The Ministry of Internal Affairs (through the National Police and National Guard), the Security Service, and the State Border Service also have some responsibility in related topics, such as improvised explosive device disposal (IEDD) and investigation of criminal offenses involving explosive ordnance. In addition, since 2016, three international NGOs have started operating in the country. The HALO Trust, the Swiss Foundation for Mine Action (FSF), and the Danish Demining Group operate under individual memorandums of understanding with the Ministry of Defense and are tasked by its Coordinating Group for Mine Action. Ukrainian commercial companies, such as the state-owned Ukroborservice, the Demining Team of Ukraine (DTU) and the newly established Demining Solutions (DS), are increasing their capacity, but, as of January 2019, are not known to be conducting clearance operations in Ukraine. The Demining Team of Ukraine, however, has carried out non-technical survey (August–September) and mine risk education (May–June) on government-controlled areas in Luhanski Oblast since 2018.
10. Helga Pender, Program Manager, Instrument Contributing to Stability and Peace, Delegation of the European Union to Ukraine, asserts the lack of national mine action legislation did not prevent the European Union from funding actions on the ground, but the acknowledgment that those actions would have more impact if the necessary legislation was in place.
11. Mine and ERW casualties are usually recorded by different actors depending on the consequence of the accident. For instance, if the victim has died, the accident will likely be managed by the police, whereas if the victim survives, the Ministry of Health will be involved.
14. According to Gianluca Maspoli, the Geneva International Center for Humanitarian Demining (GICHD), in partnership with OSCE PCU and the Geneva Center for the Democratic Control of Armed Forces (DCACF), has supported the effort to develop a specific mine action law and NMAS. Other United Nations agencies and international NGOs, such as FSD, HALO Trust and DDG, have also contributed to the process by providing comments to the drafts and participating in several workshops to discuss the topic.
24. Yuri Shahramanian, Program Manager, The HALO Trust in Ukraine, interview by Henrique Garbino, face-to-face, 23 August 2018.
27. Both the MOD and SESU currently consider the whole of the buffer zone as a suspected hazardous area, that is, the roughly 15-kilometer (9.32-mile) wide and 500-kilometer (310.69-mile) long strip along the contact line totaling about 7,000 sq km (2702.72 sq mi). To put in perspective, more conservative estimates made by the international operators in Ukraine amount to an area of 15 to 20 sq km (5.79 to 7.72 sq mi). In addition, government authorities also include cancelled and reduced areas when counting the extension of clearance tasks, and mines and ammunition disposed of during stockpile destruction as destroyed mines and ERWs, which amount to the impressive figure of 27.7 sq km (10.70 sq mi) of cleared land and about 370,000 destroyed mines and ERWs since 2014.
29. Tymur Pstruch, Executive Director, Demining Solutions, and Head of the Association of Ukrainian Defence Manufacturers’ Mine Action Cluster, interview by Henrique Garbino, face-to-face, 10 August 2018.
30. Judith Gough, UK Ambassador to Ukraine; Roman Waschuk, Canadian Ambassador to Ukraine; Maria L. Yovanovitch, US Ambassador to Ukraine; Hermine Popplewell, Austrian Ambassador to Ukraine; Ernst Reichel, German Ambassador to Ukraine; Davide La Cecilia, Italian Ambassador to Ukraine; Ole T. Horpestad, Norwegian Ambassador to Ukraine; Marek Safin, Slovakian Ambassador to Ukraine; Isabelle Dumont, French Ambassador to Ukraine; Ed Hoeks, Dutch Ambassador to Ukraine; Hugues Mingarelli, Head of the EU Delegation to Ukraine; and Mateja Kračun, Chargé d’Affaires a.i. of the Embassy of the Republic of Slovenia to Ukraine; “Letter dated 1 February 2019 from the heads of mission of the mine action donor community addressed to Mr. Andriy Paruby, Speaker of the Verkhovna Rada,” 1 February 2019.
32. Henry Leach, Head of Program, Danish Demining Group in Ukraine, interview by Henrique Garbino, face-to-face, 22 August 2018.

The Challenges of Humanitarian Mine Clearance in Ukraine by Robinson and O’Keeffe | from page 17 |

Contamination in Eastern Ukraine: Observations by OSCE SMM by Crowther | from page 24 |
2. Editor’s note: The OSCE SMM uses preferred language to refer to the parties to the conflict. The term sides is the approved language of the organization and is used by the OSCE SMM
in its daily reports.

3. Editor’s note: Armored formations is the approved language of the OSCE SMM to refer to the non-government forces.


6. This article acknowledges the updated IMAS definition of ‘ATM/AVM’ adopted on 27th July 2018, but for the sake of brevity will utilize only AVM.


Mineland: The Endless War by Rorandelli [ from page 27 ]


ITF Enhancing Human Security in Serbia by Sančanin [ from page 37 ]

1. Slovenia based and established as International Trust Fund for Demining and Mine Victims Assistance (ITF) in March 1998, and since January 2012 operating under the new name ITF Enhancing Human Security.

2. SFRY also introduced two administrative autonomous provinces within Serbia, namely Vojvodina in the north and Kosovo (and Metohija) in the south, largely autonomous but as integral parts of Serbia.

3. Without consent and boycott by the majority of Serbian ethnic population in Croatia and Bosnia and Herzegovina.

4. Kosovo being an integral part of Serbia.

5. Serbia recognized in UN with its full territorial scale, Kosovo being subject to UN SCR 1244.

6. As a consequence of 1999 NATO bombing campaign.

7. The territory of Kosovo / Kosovo and Metohija is herein not included, as it is not under current authority of Mine Action Centre of Serbia; further related to UN SC Resolution 1244; and not taking into consideration any unilaterally or bilaterally concluded documents or agreements.

8. For problematics of other unexploded ordnance on land and in rivers, as well as air-bombs/rockets, see general problem descriptions at http://www.crrs.gov.rs/eng/minska-situcija.php.

9. In the aftermath of NATO military intervention, on 10 June 1999 UN SC adopted Resolution 1244 according to which the Kosovo (and Metohija) is governed by the United Nations Interim Administration Mission in Kosovo, and vouching Serbia’s territorial integrity. The Assembly of Kosovo adopted the unilateral declaration of independence on 17 February 2008. Serbia rejects this independence and claims Kosovo (and Metohija) as its integral and indivisible part of territory according to Serbia’s Constitution. Therefore, all references within this article shall be without any prejudice to positions on status.

10. not including here the territory of Kosovo (and Metohija).


12. For the projects by/through ITF Enhancing Human Security, the USA, Norway, Germany, Republic of Ireland, Czech Republic, Serbia/Ministry of Capital Investments, provided funding.

13. Listing the municipalities where the projects were executed by and through ITF.


15. Still cluster bomb affected, the Niš city residential area of Medeoevac is planned to be cleared only as late as in 2019.

16. Still the remaining cluster bomb affected Kopaonik area of Pančićev vrh is planned to be cleared only in late 2019.

17. Due to its valuable ecosystem, Kopaonik became a national park in 1981. Kopaonik National Park covers an area of 11,810 hectares and based on the number of endemic species, it is one of Serbia’s most important biodiversity hotspots for endemic flora. http://www.crrs.gov.rs/kopaonik-mountain-resort/


19. For demining of this area, ITF provided funds from donations of the USA, Spain, Germany, Norway, Canada, Czech Republic and EU for implementation of 43 projects, while one project was funded by the Building Directorate of Serbia. http://www.crrs.gov.rs/eng/minska-situcija.php

20. 43 mine-clearance projects executed in Serbia (5%d) were performed by donor funds through ITF, clearing over 5.7 square kilometers (2.2 square miles) of land and removing 4,464 mines and 646 pieces of UXO.


22. Mine-contamination also obstructed effective border police activities on borderlines with Croatia and Bosnia and Herzegovina.

23. North of/along the administrative line with Kosovo and Metohija. For the non-biased and fair treatment, the term Kosovo (and Metohija) is used purely as a geographical definition.

24. ITF providing donor funding for the NPA’s survey project implementation.

25. The so-called groups of mines as defined by MACS, presumably set up by the Albanian paramilitary groups.

26. Survey by Norwegian People’s Aid (NPA) in cooperation with ITF, MACS. http://www.crrs.gov.rs/eng/minska-situcija.php


28. In its transparency report submitted in 27 December 2006, Serbia reported that it had completed the destruction of all stockpiled anti-personnel mines. In total, Serbia reported having destroyed 1,404,819 mines. https://www.apminebanconvention.org/states-parties-to-the-convention/serbia/

29. Held from 28 to 30 November 2018.


32. Serbia donated its own funds also in 2006.
Lessons from the Past: Minefield Clearance and Casualties – Holland 1945 – Military Operational Research Unit Report No.7 by Evans | from page 40 |
7. Original records found in the Minefield Records Office. Stichting Geschiedkundige Verzameling EOD, Soesterberg.
26. Email from Antoon Meijers to the author, 05 April 2019.

Accidents and Field Medical Provision by Smith | from page 47 |
The reports of the accidents listed below can all be found in the JMU repository at https://commons.lib.jmu.edu/cisr-dda/
1. The stretcher shown in the photograph was used to carry mines to the demolition area. It was not the stretcher issued to the medic.
2. The study was conducted for U.S. Army CECOM NYSED by the author in 1993.

Drones in the Desert: Augmenting HMA & Socio-Economic Activities in Chad by Fardoulis, Depreytere, Sauvage, and Gallien | from page 62 |
Distinguishing Conflict and Post-Conflict Environments

Ambiguously referred to as “the gray zone,” the existential differences between conflict and post-conflict are becoming increasingly blurred. The situation in Mosul has demonstrated the need for international clearance teams to begin operations despite ongoing operations by international armed forces. In areas where humanitarian access is possible, how do organizations mitigate the risks associated with unexploded ordnance? What lessons can be learned from this region and applied to current conflict zones such as Syria? Discussion of current clearance programs and adaptations to clearance requirements in urban environments? What lessons can be learned from this region and applied to current conflict zones such as Syria? Discussion of current clearance programs requires not for international cooperation to combat these threats. Is more widespread application of the International Ammunition Technical Guidelines (IATG) the solution? What can be done to make the IATG more user-friendly and applicable for States with limited resources and training? And how can organizations that conduct safe and secure management of ammunition translate their experiences into lessons learned that serve the broader community? What lessons are organizations making in places like Eastern Europe and elsewhere in the world to prevent UEMS and monitor potential risks?

Safe and Secure Management of Ammunition

Unplanned explosions at munitions sites (UEMS) worldwide, as well as the ongoing illicit proliferation of ammunition due to poor physical security and stockpile management (PSSM) practices at arms depots, highlight the need for increased international cooperation to combat these threats. Is more widespread application of the International Ammunition Technical Guidelines (IATG) the solution? What can be done to make the IATG more user-friendly and applicable for States with limited resources and training? And how can organizations that conduct safe and secure management of ammunition translate their experiences into lessons learned that serve the broader community? What lessons are organizations making in places like Eastern Europe and elsewhere in the world to prevent UEMS and monitor potential risks?

Research and Development

The Journal of Conventional Weapons Destruction 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, NGOs, and researchers are encouraged to submit. R&D articles are submitted to three experts for anonymous peer review. Two of the three reviewers must approve the article for publication. Reviewers approve articles for publication, suggest revisions or reject articles for publication.

Middle East

With a long list of modern conflicts, the Middle East continues to experience insecurity as well as numerous explosive hazards. The Iraq War, civil wars in Libya, Syria, and Yemen; the rise and fall of the Islamic State of Iraq and Syria (ISIS), and multiple insurgencies all contributed to regional instability and extensive explosive contamination. How are organizations adapting to the challenge of working in such complex and dangerous environments? How do organizations that conduct safe and secure management of ammunition translate their experiences into lessons learned that serve the broader community? What lessons are organizations making in places like Eastern Europe and elsewhere in the world to prevent UEMS and monitor potential risks?

Afghanistan

As one of the most mined countries in the world, how are organizations working in Afghanistan countering legacy landmines and the removal of improvised explosive devices (IED), while incorporating community awareness and risk education into clearance operations? How are organizations adapting to clearance requirements in urban environments? What lessons can be learned from this region and applied to current conflict zones such as Syria? Discussion of current clearance programs is encouraged.

Afghanistan

As one of the most mined countries in the world, how are organizations working in Afghanistan countering legacy landmines and the removal of improvised explosive devices (IED), while incorporating community awareness and risk education into clearance operations? How are organizations adapting to clearance requirements in urban environments? What lessons can be learned from this region and applied to current conflict zones such as Syria? Discussion of current clearance programs is encouraged.

Middle East

With a long list of modern conflicts, the Middle East continues to experience insecurity as well as numerous explosive hazards. The Iraq War, civil wars in Libya, Syria, and Yemen; the rise and fall of the Islamic State of Iraq and Syria (ISIS), and multiple insurgencies all contributed to regional instability and extensive explosive contamination. How are organizations adapting to the challenge of working in such complex and dangerous environments? How do organizations that conduct safe and secure management of ammunition translate their experiences into lessons learned that serve the broader community? What lessons are organizations making in places like Eastern Europe and elsewhere in the world to prevent UEMS and monitor potential risks?