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POLICY PERSPECTIVE

Bombing for Biodiversity—Enhancing Conservation Values of Military Training Areas

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Abstract

Global defense spending is $US1753 billion annually or approximately 2.5% of the world GDP. Significant time and resources is spent in training 28 million defense personnel worldwide. Much of this training on land takes place within specifically designated military training areas (MTAs). Globally, the size of the MTA estate is likely to be very large, but just how large is unknown. Our preliminary analyses has identified that MTAs cover at least 1% of the Earth's surface. This figure is believed to be closer to 5–6% as no verifiable data exist for the majority of Africa, South America and Asia. MTAs occur in all major global ecosystems and have the potential to increase the global protected area network by at least 25%. MTAs therefore have an important complementary role to play in global conservation. However public policy makers, the scientific community, government agencies, and nongovernment organizations have largely ignored MTAs as a conservation resource. To realize the potential major contribution to conservation that MTAs can play we propose four key policy changes: (1) better document the environmental values of MTAs, (2) develop integrated MTA land management models, (3) increase dedicated financial resources for the land management of MTAs, and (4) strengthened global leadership to manage MTAs as an environmental resource.

Introduction

Global defense spending is $US1753 billion annually or 2.5% of the world's GDP (SIPRI 2014a). Massive industries develop, build, and supply weaponry to support the world's militaries. Significant time and resources is then spent in training 28 million defense personnel worldwide to use this weaponry. Much of this training on land takes place within specifically designated military training areas (MTAs) (Figure 1). Globally, the size of the MTA estate is very large, but just how extensive is unknown. Moreover, the environmental and conservation values of this large estate are either unknown, poorly documented or both.

Here, for the first time, we present a global overview of the conservation value of the world's MTAs. We suggest that the MTA estate is likely to be representative of the world's ecosystems and have significant conservation value and implications for conservation planning. We further suggest that, with appropriate integrated management, the MTA estate has the potential to play critical complementary roles alongside the formal protected area estate (e.g., International Union for the Conservation of Nature (IUCN) protected areas categories I–IV). We propose four key policy changes to maintain or enhance the contribution MTAs make to biodiversity conservation: (1) better document environmental values of MTAs, (2) integrate military and conservation objectives in MTA management, (3) properly resource integrated MTA management, and (4) strengthened political leadership to integrate military training, conservation policy, and planning.

The extent of the global MTA estate

We conducted a review of peer reviewed and gray literature on MTAs. There was a paucity of published articles (only 90 articles met our search terms; see

Table 1 Area of MTAs globally identified

Country	Dedicated military training area (hectares)	Reference
World's 20 largest countries		
Russia		http://eng.mil.ru/en/index.htm
Canada	1.8M	http://www.forces.gc.ca/en/index.page
United States	18M	http://www.denix.osd.mil/sri/upload/SRR2013.pdf http://www.globalfirepower.com/country-military-strength-detail.asp?country_id=United-States-of-America
China		http://www.globalfirepower.com/country-military-strength-detail.asp?country_id=china
Brazil		http://en.wikipedia.org/wiki/Brazilian_Army http://www.defesa.gov.br/
Australia	15.4M	http://www.defence.gov.au
India		http://www.bharat-rakshak.com/
Argentina		http://www.mindef.gov.ar/ http://www.ejercito.mil.ar/sitio/index.asp
Kazakhstan	11M	McDermott 2012 (McDermott 2012) http://subweb.diis.dk/graphics/Publications/Reports2012/RP2012--15-Kazakhstan-Russia_web.pdf
Algeria		Unable to access government website 26/3/14
Democratic Republic of the Congo		Unable to access government website 26/3/14
Mexico		http://www.sedena.gob.mx/index.php/
Saudi Arabia		http://www.moi.gov.sa/
Indonesia		http://indonesia.go.id/en/ministries/ministers/ministry-of-defense/1656-profile/185-kementerian-pertahanan
Sudan		Unable to access government website 26/3/14
Libya		Unable to access government website 26/3/14
Iran		Unable to access government website 26/3/14
Mongolia		http://zasag.mn/ (Unable to translate)
Peru		http://www.indeci.gob.pe/
Chad		Unable to access government website 26/3/14
Opportunistic searches		
Germany	714,000	http://www.bmvg.de/ http://de.wikipedia.org/wiki/Truppen%C3%BCbungsplatz
France	103,000	http://fr.wikipedia.org/wiki/Liste_des_garnisons_de_l%27Arm%C3%A9e_de_Terre#Tunisie
New Zealand	83,000	http://nzdf.mil.nz/corporate-documents/default.htm and http://nzdf.mil.nz/downloads/pdf/public-docs/2012/bim/bimbackgroudinfo.pdf
Czech republic	129,600	O. Cizek *et al.* PLoS ONE **8**, 1 (2013)
UK	160,000	https://www.gov.uk/defence-infrastructure-organisation-and-the-defence-training-estate
Poland	194,863	www.docstoc.com/docs/50608606/militray-training-area-in-poland
Latvia	108,509	S. Beneza and J. Balodis. European Integration and Baltic Sea Region: Diversity and Perspectives (2011)
Finland	107,000	Environmental Assessment Model for Military Training Areas in Finland Largest TA

Supplementary Materials) and no articles examined MTAs globally. As a comparison, we undertook a basic search using Supersearch based on the terms "environmental conservation" that identified 1,856,762 references (Supersearch 2014). This paucity of studies, coupled with potential security issues, mean that the total global area and distribution of MTAs is currently unknown (Lee Jenni *et al.* 2012). Based on the articles we identified, together with mapping information and official government internet sources (see Supplementary Materials), we estimate the size of terrestrial MTA estate to be least 50 million ha globally, an area roughly the size of France (Table 1). However, this figure is likely to significantly underestimate the actual area as only five of the world's 20 largest nations detail the area of their MTAs on their government websites; there are no verifiable data on MTAs for Africa, Asia and South America (Figure 2). We note that the world's 20 largest nations include nine countries that are regarded as biodiversity hotspots (Australian Department of the Environment 2014). These countries are Australia, Brazil, China, The Democratic Republic of the Congo, India, Indonesia, Peru, the United States, and Mexico. Seven of the world's 20 largest countries are in the top 15 countries for military expenditure in 2013 (SIPRI 2014b). The combined expenditure of the United States, China, Russia, Saudi Arabia, India, Brazil, and Australia accounts for approximately 62.8% of all global military expenditure.

Our review revealed temporal changes in the size of the global MTA estate. The size of the MTA estate is decreasing in some regions such as in Eastern Europe, where nations like the Czech Republic and Latvia are divesting their holdings (Gazenbeek 2005; Doyle & Havlick 2009). In contrast, data from the United States, Russia, and Australia reveal an increase in the area of MTAs over the last 15–20 years. The U.S. military has been increasing its training estate by approximately 1,200 ha per year (Global Security 2014). Russia is currently building four new large scale MTAs (Russian Department of Defense 2014) and Australia has increased its MTA estate by approximately 1 million ha since the early 1990s (Australian Department of Defence 2014). Advances in technology, requiring larger training and buffer areas, have driven this increase with modern army brigades requiring an average area of 50 × 100 km to train compared to just 8 × 10 km during World War II (Durant 2010). Our review was unable to identify whether the global area of MTAs is increasing, decreasing or remaining relatively static. Nevertheless, the area of MTAs globally is significant.

Conservation value of MTAs

Using the PRISMA protocol (Sato *et al.* 2013) our review identified no articles providing a global assessment of the conservation values of the MTA estate; three articles assessed the conservation value of specific MTAs and 15 quantified MTA use by specific taxa. The dearth of global literature suggests the majority of policy makers, environmental organizations, and the scientific community remain largely unaware of the environmental values of MTAs. Some studies indicate particular MTAs can have high conservation values. The European Commission's Natura 2000 program recognized the conservation value of MTAs for rare and endangered species and threatened habitats (Gazenbeek 2005). Warren *et al.* (2007) found unusually high biodiversity in current and former MTAs in Europe. The Lehnin MTA near Berlin, Germany is home to a wolf pack—the first seen in Germany in nearly 100 years. The disciplines of both military geography, which is the study of geographical topics from geopolitics to environmental conditions that may impact on military operations and the study of military history touch tangentially on the environmental values of MTA (see Woodward 2004, Pearson *et al.* 2010, and Pearson 2012). These works, however, do not investigate the biodiversity conservation values of MTAs in great detail both locally or at a global scale.

While some work attempts to uncover the reasons for the environmental values of MTAs, results to date are contradictory, thereby highlighting deficiencies in knowledge and understanding. For example, Warren *et al.* (2007) speculates that high biodiversity values of European MTAs are linked to heterogeneous landscapes created by training activities, whereas Gazenbeek (2005) suggests the high conservation values of MTAs result from them being undisturbed refuges for biota. In the United States the "weapons to wildlife" initiative (Havlick 2011) has resulted in a number of MTAs being transferred the U.S. Fish and Wildlife Service as nature reserves. Understanding the drivers of the conservation value of MTAs will better inform their future management.

Because military forces train in environments they may potentially operate in (Coulson 1995), MTAs are likely to be strongly representative of the world's terrestrial biomes and ecosystems. MTAs can encompass areas that might otherwise not be captured (or only poorly represented) within formal reserve systems. Hence, MTAs may have an important complementarity role (sensu Margules & Pressey 2000) to formally protected areas. For example, Shoalwater Bay MTA in Queensland is the largest remaining area of sub-tropical coastal heathland on the Australian east coast—an ecosystem type which is relatively poorly protected in formal reserves on the continent and subject to major human modification outside the reserve system (Keith *et al.* 2014).

Although some MTAs are degraded as a result of high-intensity training activities and exercises, many remain in relatively good ecological condition. Fort Carson, Colorado, in the United States is an example of a MTA that is heavily used but supports high quality natural prairie (Herring 2004). MTAs can maintain high habitat value because they are not subject to pressures

Figure 1 Clockwise from top left: Shoalwater Bay Training Area, Australia; a tank manoeuvring at a German military training area, German MTAs are proving to be refuges for wolf packs in western Europe; live fire exercise; Makua Military Reserve, Hawaii; Tully Field Training Area, Australia; military trainings areas contain varied landscapes including escarpments and coastal heathland. (Images Courtesy of the Australian Department of Defence, U.S. Department of Defense).

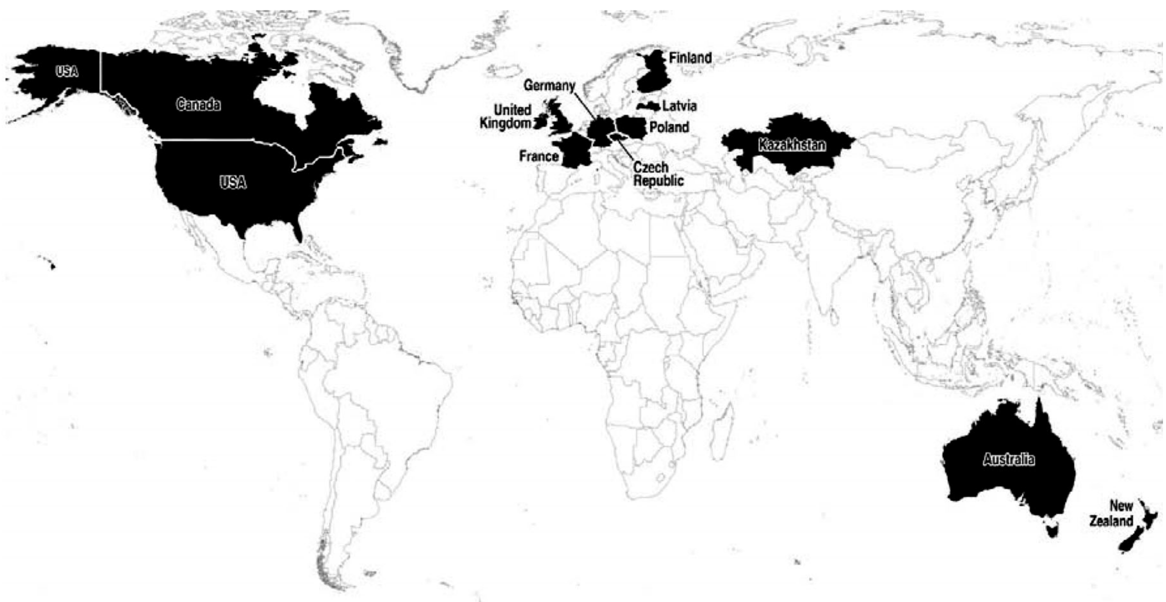

Figure 2 Countries where the area of MTAs is known.

like logging, land clearing, agriculture, and urbanization which are degrading the formal reserve systems of many nations (Mascia & Pailler 2011). This is, in part, because they contain unexploded ordnance (Havlick 2011). Thus, for ecosystems already in reserve systems but at risk of degradation, similar ecosystems within MTAs may play an "insurance" role by maintaining the values and biodiversity of those environments.

Key policy changes

While the primary purpose of MTAs will always be military training, their large area, global distribution and representativeness, means they are likely to have significant environmental and conservation values. Indeed, if managed appropriately, MTAs have the potential to augment the global terrestrial protected area network by a conservatively estimated further 4 percent beyond the existing ~12% of the earth's land surface. To realize this potential major contribution, we suggest four key policy changes are required.

Better document the environmental values of MTAs

The current location, extent, and environmental values of MTAs are poorly understood. Our review indicated that only 49 articles have been published in environmental journals, which is remarkable given the size of the estate. Our review also revealed that it has been only in the last 30 years that countries such as Australia, United States, Canada, United Kingdom, Germany, France, Finland, Portugal, and the Czech Republic have become cognizant of the environmental values of their MTAs and taken steps to protect them (e.g., Gazenbeek 2005). Key knowledge gaps such as MTA location and area, coupled with fundamental environmental data like species occurrence and ecosystem integrity, need to be addressed. These data will allow for informed environmental management and improved understanding of how MTAs complement existing reserve and protected areas.

Security issues, risks associated with working on MTAs (e.g., the presence of unexploded ordnance), and the treatment of MTAs as an environmental resource will necessitate the development of novel approaches to data collection, monitoring and land management. Secrecy issues relating to location of training facilities, types of training and the use of new technology will require the development of novel data sharing models that do not compromise national security. Risks associated with unexploded ordnance also will necessitate the development of new ways to collect environmental data.

Develop integrated MTA land management—"Military Land Management Policies are Environmental Policies"

Our review revealed there is currently no common global understanding of, nor the ability to fully integrate environmental considerations into, the management of MTAs. Attempts to integrate environmental considerations into MTA management are underway in some nations. However, approaches to date have been "add-ons" such as sustainability monitoring and reporting plans (in Australia), but these are not part of a formal integrated management regime. In the United States, environmentally important sites are excluded from training activities. Nevertheless, the U.S. military is still considered to have only a very limited environmental focus (Durant 2010). We therefore argue there is a need for new models and approaches to integrate military training and conservation in MTAs. The importance of integrating conservation with other kinds of land use practices such as fisheries, forestry, and agriculture has long been recognized (e.g., Fischer *et al.* 2008; Gustafson & Loehle 2008), but there are no equivalent models for MTAs. We suggest there is merit in adapting ideas, principles and practices from fisheries, forestry, and agriculture. However, due to the unique nature of land use in MTAs, these principles and practices will need to be modified and evolved to facilitate the achievement of environmental outcomes. Novel approaches in the use of management zoning and training activity management coupled with approaches currently not used in land management such as the establishment of sacrificial zones (where use is high intensity and frequent) will be important for promoting biodiversity conservation in MTAs.

"Military Training Policy" should be "Environmental Policy" when it comes to managing MTAs. Effective strategies for integrating conservation with military training will demand applied research to quantify positive and negative environmental impacts. To do this will require the military, scientists and public policy makers to collectively analyze key baseline environmental, economic, and military data to determine management regimes that sustain military training utility, environmental values, and economic efficiencies.

Financial resources

In 2012, annual military expenditure by governments around the world was estimated at $1,753 billion and is increasing (SIPRI 2014a). This figure includes the management costs for at least 50 million ha of MTAs. Mandating that a small proportion of defense expenditure be refocused toward good environmental land stewardship would have a significant positive impact on global biodiversity conservation. Based on the work of McCarthy *et al.* (McCarthy *et al.* 2012), we estimate only 1%, (~$17 billion annually), of the global defense budget would be required to ensure all MTAs have fully integrated land management practices in place (see Supplementary Materials). As world militaries already spend a proportion of their budget on the management of MTAs, we believe that the true cost of such an initiative would be minimal as it would involve the redirection and reprioritization of existing funds. However, the World Bank (World Bank 2014) conservatively estimates that effective integrated land management can deliver budget savings of 5–10% compared to nonintegrated management costs. For MTAs, these savings would be achieved through more efficient management practices resulting in less environmental degradation and, in turn, reduced remediation and rehabilitation.

Leadership

Conflict between the "environmental agendas" of government and national security considerations has resulted in MTAs being managed as a military resource with only limited consideration of their environmental and conservation values (Woodward 2001; Coates *et al.* 2011; Lee Jenni *et al.* 2012). Leadership, both nationally and internationally, at the highest levels of government is required to bring together "environmental" and military considerations and recognize MTA management policy as a form of environmental conservation policy. Internationally, no central agency exists to lead and drive this change. The IUCN could take a leadership role in three key ways. First, by explicitly recognizing the conservation value of MTAs. Second, by assisting environmental data collection. Third, by creating a new conservation classification that formally includes a new category of MTAs with subcategories reflecting quantified assessments of the condition, integrity, and quality of management of these areas. The neutrality of the IUCN, in terms of not being aligned to any one country, would make it the ideal body to lead this work.

Conclusion

The total area and distribution of MTAs globally has not previously been assessed, nor have the potential global environmental and conservation value of MTAs. Preliminary analysis indicates that due to their sheer size, distribution, and coverage of an array of ecosystems, MTAs have the potential to make a significant formal contribution to biodiversity conservation, being recognized as a global biodiversity resource in their own right. Indeed, the conservation role of MTAs may ultimately be crucial given that more than 50% of the important sites for biodiversity conservation worldwide are not formally protected (Butchart *et al.* 2012). Therefore, developing an integrated land management approach to MTAs is both a significant opportunity and a challenge for the military, scientific and policy communities but could result in important biodiversity conservation benefits at local, regional, and global continental scales.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Literature Review
Global Area of MTAs
MTA Management Financial Costing

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