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The consequences of establishing military training areas for land use development—A case study of Libavá, Czech Republic

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ABSTRACT

This article presents results on the long-term (from 1837 to 2014) development of land use and a road network in the military training area of Libavá, the Czech Republic, and its surroundings. The key hypotheses were that the establishment of military training areas has significant impacts on the development of their land use and the road network, which are manifested mainly in an increase of forest and/or grassland use/cover, and that military training areas are affected by general trends of land use changes; however, trends connected with specific military needs still dominate. Results show that there are indeed differences in the land use development and land use change transitions in the training area and its surroundings. These were most pronounced during the most intensive military activities in the past 70 years. During this period the training area experienced massive grassing, afforestation and vegetation succession, while the surroundings were used for intensive agriculture and economic development, resulting in the spread of arable land as well as the spread of built-up areas. The road network in the area was also affected by the military regime – direct connections between towns were lost, and many roads were destroyed or lost their importance. Currently, with the withdrawal of the military from almost a third of the training area, both the training area and its surroundings are again being affected by similar driving forces, namely the spread of organic farming and implementation of agri-environmental schemes, resulting in extensive grassing. This trend will likely continue. We believe that land use development in the military training area can serve as a proxy for future land use development in recently abandoned regions.

1. Introduction

Military training areas (MTAs) have above all a military-strategic purpose. Despite their specific military utilization, however, MTAs can also host high biodiversity (Havlick, 2007; Warren et al., 2007; Reif et al., 2011). Some MTAs contain valuable preserved historical landscape structures that were not affected by the agricultural intensification that was often common in surrounding landscapes, and thus play an important role in biodiversity hotspots (Špulerová et al., 2013; Hreško et al., 2015). At the same time, some historical landscape structures, including settlements, have been destroyed in those parts actively used for military purposes, such as tank training grounds, impact sites, training grounds for infantry, and shooting ranges. Despite the rather negative impacts on historical landscape structures, there is an undeniable positive relationship between some military activities and the presence of plant and animal species, e.g. species that thrive in terrain depressions and partly bare training grounds disturbed by the movement of military vehicles, species of initial vegetation succession on localities disturbed by fire from ammunition, etc. (Wang et al., 2014; Čižek et al., 2013). Military activities can create a variety of biotopes that offer suitable conditions for a wide range of species, often with opposing habitat requirements. The cessation of military activities often leads to spontaneous vegetation succession, which then causes the extinction of valuable plant and animal species (Warren et al., 2007; Warren and Buettner, 2008).

The establishment of an MTA significantly affects the land condition (Wang et al., 2014; Althoff et al., 2007), land cover (Anderson et al., 2005), use and management (Raška and Kirchner, 2011). Land use change processes inside MTAs are often very different from global trends in surrounding landscapes, as described by e.g. Van Vliet et al.

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(2015) or Skokanová et al. et al. (2016a,b); . Land use changes in MTAs are not driven by common economic forces but rather by the systematic and planned management of MTA authorities.

Besides land use and management, the establishment of an MTA also affects the living conditions of people in the MTA and surrounding regions. These regions often suffer from depopulation, higher unemployment rates, a lack of jobs, insufficient public facilities, inadequate educational structure, etc., which are typical for marginal areas (Seidl and Chromý, 2010; Seidl et al., 2010). The establishment of an MTA creates a barrier in connecting regions surrounding them, therefore strongly affecting transport services and road networks. The development of a road network in an MTA faces other challenges, such as optimisation of road networks in order to maintain roads for the purpose of military training and at the same time reducing negative impacts on the environment (Johnson et al., 2011).

Old topographic military maps and aerial photographs are excellent resources for capturing the long-term impacts of the establishment of MTAs on land use and management as well as road networks. These resources provide information on the situation before and after the establishment of the MTA, which in Central Europe may have already been affected by military uses in the 19th and early 20th centuries (e.g. Hirst et al., 2000; Olsen et al., 2007). They also help in understanding the human impacts on environmental and ecological processes, and provide insights into the cultural heritage of landscapes (Fuchs et al., 2015). Land use maps based on these sources, and their derivatives such as maps showing the continuity of individual land use categories or maps of land use change processes (Skokanová et al., 2012; Havlíček and Chrudina, 2013), can be further used in ecological assessments or in studies dealing with biodiversity. They can also help land managers better plan their activities. For instance, when planning the creation of new water bodies land use maps depicting the location of old ponds can serve as a guideline where they might best be situated (Havlíček et al., 2014; Pavelková et al., 2016).

Despite the importance of MTAs on the surrounding landscape, there are very few studies analysing the long-term development of land use before and after the establishment of MTAs (e.g. Raška and Kirchner, 2011; Olsen et al., 2007). Existing studies usually analyse the impact of military activities on land cover during the existence of an MTA (e.g. Anderson et al., 2005; Hirst et al., 2000; Hutchinson et al., 2015), biodiversity (e.g. Warren et al., 2007; Čížek et al., 2013), or how the MTA can be successfully redeveloped (e.g. Bagaeen, 2006; Ashley and Touchton, 2016).

This article therefore tries to stimulate a discussion about to what extent MTAs affect the development of their land use and management as well as associated road networks in comparison to their surroundings and other regions in Central Europe with similar natural conditions, and if they can serve as a proxy for land use development in recently abandoned regions. In particular, we attempt to verify the following key hypotheses:

1) The establishment of MTAs has significant impact on the development of their land use and the road network, which manifests mainly in an increase of forest and/or grassland use/cover,
2) MTAs are affected by general trends of land use changes; however, trends connected with specific military needs dominate.

2. Study area

To test our hypotheses, we chose the Libavá MTA, which is situated in the eastern part of the Czech Republic, near the regional city of Olomouc (Fig. 1). For land use analyses an area of 738 km^2 was selected, which includes the MTA and its immediate surroundings, and for analysing the road network in historical context a wider area of 2 200 km^2 was selected. This wider area for the road network analysis was selected in order to capture changes in major routes connecting the regional seats of Olomouc in the west and Ostrava in the north-east, and also significant district towns (Opava in the north-east, Moravský Beroun and Šternberk in the north, Lipník nad Bečvou and Hranice in the south, and Odry in the east).

The Libavá MTA was established in 1950 on an area of 327 km^2, becoming the second largest MTA in the Czech Republic. This size was also the basis for land use change analyses, despite the fact that the MTA itself underwent shrinkage at the beginning of 2016, losing 31 % of its area to surrounding municipalities, as a part of a general optimisation of Czech MTAs. Since land use changes were analysed using maps and orthophotos preceding this optimisation, this process did not affect our analyses. The Libavá MTA is a training ground for tanks, artillery and infantry. Only one third of the current area is actually used for training purposes, while the rest is managed by the Military Forest and Farms authority.

The Libavá MTA is drained by the Odra river, which has its source spring within the MTA. In contrast, the surroundings are predominately drained by the Morava river tributaries, with only part of the north-eastern region belonging to the Odra catchment. While the Libavá MTA can be considered as an upland region, its surroundings show a gradient from uplands in the northwest to the floodplain in the south (Fig. 1). Differences in the relief between the Libavá MTA and its surroundings (Fig. 1) are also reflected in the climate: while in the MTA the average annual temperature is 6–7 °C and average annual precipitation 700–800 mm, in the surroundings the average annual temperature is 7–9 °C and average annual precipitation 550–700 mm (Tolasz, 2007).

The entire MTA is recognized as a special protected area (SPA) according to EC Directive on the conservation of wild birds (79/4/09/EEC). The main protected birds and their habitats are those of the corncrake (*Crex crex*), black grouse (*Tetrao tetrix*), snipe (*Gallinago gallinago*), meadow pipit (*Anthus pratensis*), whinchat (*Saxicola rubetra*), stonechat (*Saxicola torquata*), red-backed shrike (*Lanius collurio*) and the corn bunting (*Miliaria calandra*). One third of the MTA (108 km^2) is covered by a NATURA 2000 site of community importance (SCI) according to EC Directive on the conservation of natural habitats and of wild fauna and flora. This SCI also extends into the MTA surroundings, especially into the western part. There are also ten additional SCIs in the surroundings, but they cover much a smaller area (about 8 km^2). The main protected habitats in the SCIs are beech forests, oak-hornbeam forests, ravine forests, meadows and floodplains of water courses (Hora et al., 2002).

The Libavá MTA has the highest population of all Czech MTAs, with 972 at present, and had a much higher population in the past. The population peak was at the end of the 19th century, when the population was more than 13,900 and there were 27 settlements in the MTA with additional hamlets. The population was predominantly of German origin, not only in the Libavá MTA (not yet established) but also in its surroundings − in the 1930 census, the average proportion of Germans exceeded 98% of present population and some settlements had only a German population (Anonymous, 1935). This drastically changed after 1945 when the Germans were expelled by the Beneš decrees. The drastic drop of population from 12,000 in 1930–5,000 in 1950 (Balcar et al., 2006) also played a role in the government's decision to establish the Libavá MTA in that particular region. Active utilisation of the MTA for military activities led to further depopulation, with 31 settlements being demolished and only 5 settlements remaining.

The region surrounding the MTA also suffered from depopulation, again triggered by expulsion of the German population after 1945. However, other forces also played a role, e.g. restricted economic activities and jobs due to the presence of the military and worsened conditions for education. During the second half of the 20th century, however, the population gradually increased even though it never reached its pre-war numbers (Fig. 2).