

Battling Blackthorn

For the past five years, the leadership at the US Army Europe's (USAREUR) Joint Multinational Readiness Center (JMRC) in Germany has been trying to effectively manage the advancement of the Blackthorn bush across its Hohenfels Training Area (HTA). And it has been one of their toughest challenges.

"The early growth stage of Blackthorn is rather slow, but if left unchecked, it can reach a height of 4 meters (13 feet)," said Dr. Albert Boehm, the Directorate of Public Works, in the Environmental Branch of USAG Bavaria-Hohenfels. "It becomes incredibly dense and, with its extensive root systems, it can cover large areas really quickly. Its thickness and sharp thorns make it impenetrable, which reduces the available training areas and greatly affects the soldiers' ability to move around safely."

Compounding the encroachment issue is the fact that approximately 92 percent of the 160- km² (61-mi²) training area has been designated a flora-fauna and bird habitat protection area under the European Union's directive known as Natura 2000 FFH. That has presented USAREUR with a challenge—how to balance the military's training needs with an elevated responsibility to protect threatened species and habitats.

In response, the JMRC launched a first-of-its-kind project to bring the Blackthorn under control, while staying true to the protected nature of the site. Using a combination of high-resolution 3D Light Detection and Ranging (LiDAR) data, satellite and aerial imagery and Trimble's eCognition image analysis technology, the JMRC was able to not only identify and map the Blackthorn's movements, it also gathered the needed intelligence to develop strategies to proactively manage the invasive bush.

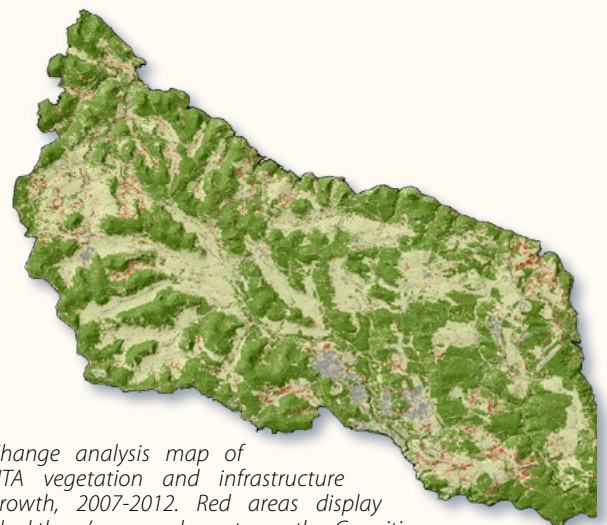
A Thorn in Their Side

As the second-largest active training facility in Germany, the HTA has served as fertile grounds for military exercises since 1938. Training

rotations have fluctuated over the years, but after 9/11, troop numbers training at HTA dropped dramatically as they were deployed for battle, creating a significant downturn in high-impact training. Fewer and smaller rotations created the perfect breeding ground for vegetation growth, particularly Blackthorn.

By 2010, the Blackthorn's encroachment on the HTA's open space was so significant, USAREUR had to activate a plan to resolve the problem.

Familiar with LiDAR data for land-management applications, in 2012 USAREUR tasked IABG, a geospatial technology company based in Ottobrunn, Germany, to acquire an updated LiDAR dataset of the HTA. Paired with other datasets, IABG would use eCognition to directly identify Blackthorn and map its encroachment patterns and extent.



Change analysis map of HTA vegetation and infrastructure growth, 2007-2012. Red areas display Blackthorn's encroachment growth. eCognition shows Blackthorn is highly impacting one-third of the HTA's 160 km² (61 mi²).

Finding Blackthorn

Elke Kraetzschmar and Sylvia Guenther, remote sensing and image analysis specialists with IABG, used a 1-m-resolution, LiDAR-derived digital elevation map (DEM) from 2007 and the 0.5-m-resolution LiDAR-derived DEM from the 2012 flight. They also acquired 8-band, 1-m-resolution optical imagery from the Worldview-2 satellite, existing aerial photos, and ancillary vector datasets. That data was integrated into the eCognition object-based image analysis software to build a customized rule set, an if-then processing tree that the software follows to determine specific vegetative types.

To verify the validity of the classification approach, the team chose four test sites, each measuring 2 x 2 km² (0.8 x 0.8 mi²). After pre-processing and validating the raster data quality, Kraetzschmar and Guenther used Esri's ArcGIS to calculate a Normalized Vegetation Index and texture layers to separate vegetation from non-vegetation areas—detail that would be integrated into the classification process—and then wrote rules to instruct the software to distinguish Blackthorn from other vegetative types based on height, spectral qualities and textural features.

In two months they had developed a classification rule set to distinguish four class types: forest, medium-high Blackthorn shrub, low Blackthorn shrub and open grassland. With the rule set created, it only took eCognition 15 hours to run the workflow and produce land-use maps for 2007 and 2012, as well as land-use change maps indicating the bush's growth in each test site between those two years.

They presented the preliminary results to the JMRC to validate the data on the ground and to show the leadership how the data could be used for building vegetation-management strategies. For the field verification, they chose 40 different Blackthorn bushes in each site and measured them using a yardstick, comparing their real-world height and shape with their classified counterpart on the map. There was not a single mismatch between what eCognition classified as Blackthorn (including its varying heights) and what was on the

ground. Based on the quality of the test sites classifications, the classification methodology was extended across the entire site.

In September 2013, IABG delivered the classification results to the Center's leadership, showing that Blackthorn was highly impacting one-third, or about 50 km² (19 mi²), of the training area.

Changing the Tide of Battle

With an accurate inventory and map of the Blackthorn's growth stages and extent, JMRC environmental and training planners can better create cost-effective and efficient removal and control strategies.

Traditionally, the military has controlled the invasive Blackthorn species with a mix of efforts to impede the bush's growth—spot burning, mowing and a herd of nearly 10,000 sheep, who feed on the early Blackthorn growth. That costs about \$30,000 US per km². From there, the costs and management efforts rise as quickly as the Blackthorn grows.

Using the classification maps, the JMRC leadership have begun developing smart eradication plans. They have identified a number of target areas throughout the training area and determined the best, cost-effective and efficient methods to either remove the Blackthorn or greatly reduce it.

To date, approximately 200 hectares (494 acres) of Blackthorn have been treated. And because the classification datasets show them Blackthorn's extent and current heights, the military has the ability to accurately forecast the bush's growth pattern for the next five years and develop sufficient control measures to properly manage its spread.

Using this high-tech strategy, USAREUR's JMRC may have found a way to manage Blackthorn, rather than Blackthorn managing them.

See feature in Lidar Magazine's October 2015 issue: www.lidarmag.com

