

Vegetation recovery assessments in landslide-affected areas after the 2018 Hokkaido Eastern Iwate  
Earthquake

(2018年北海道胆振東部地震による斜面崩壊被災地の植生回復評価)

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The 2018 Hokkaido Eastern Iwate Mw 6.6 earthquake on September 6, 2018 triggered a large amount of landslides around the town of Atsuma in Hokkaido, northern Japan, which resulted in serious personal and property damage. Because vegetation recovery in co-seismic landslide sites plays an important role in reducing erosion and increasing land stability, the vegetation recovery assessment is crucial to landslide rehabilitation. Even early successional plants such as herbaceous species can reduce the chance of shallow re-slides or surficial erosion on landslides. In this study, a landslide-affected hilly area (about 1.6 km<sup>2</sup>) near the Apporo reservoir was selected to assess the vegetation recovery. The first objective is to assess the spatial and temporal patterns of vegetation recovery in landslide-affected areas by calculating the NDVI ratio (normalized differential vegetation index on landslide areas scaled to control sites) from Sentinel-2 satellite images for the period 2016 to 2022. To avoid outliers, this study utilized the third quartile instead of the maximum value for the calculation of the ratio. As a result, before the earthquake, the NDVI ratio was essentially around 100% per year; the value dropped to 77.4% just after the earthquake and fluctuated seasonally thereafter, reaching its highest value of 87.9% in 24 October 2021. Although the range of areas with good vegetation recovery is increasing, most areas are still at a relatively poor level of recovery and environmental factors can cause the recovery to fluctuate. It will theoretically take more than ten years to return to the pre-earthquake vegetation cover. Moreover, vegetation recovered better on gentle or very steep north-facing slopes close to the drainage system in the landslide-affected areas. The second objective is to explore the seasonal variation of multiple vegetation indices in landslide-affected areas using high-resolution multi-spectral UAV (unmanned aerial vehicle) images for the period 2021 to 2022. As a result, NDVI is more sensitive to changes in vegetation growth in the study area than NDRE, GNDVI and LCI. The results of the field survey indicate that the pioneer species in the landslide-affected area are currently predominantly herbaceous. The two vegetation types with the highest frequency of occurrence are Spear thistle (*Cirsium vulgare* (Savi) Ten.) and Fireweed (*Erechtites hieracifolius* (L.) Raf. ex DC.). The Atsuma area already has relatively well-established disaster recovery facilities, but as there is a risk of re-slides and erosion in and around the landslide-affected areas, long-term maintenance of the recovery facilities and monitoring of the recovery of vegetation in the areas are both essential.