Geophysical Research Abstracts
Vol. 20, EGU2018-796-1, 2018
EGU General Assembly 2018

Determining the impact of the Eurasian Beaver (*Castor fiber*) on the vegetation and wetland structure of a riparian system using structure from motion (SFM) photogrammetry.

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Beavers, via a range of engineering behaviours, cause major alterations to surrounding habitat, ecological composition and hydrological processes. Increases in biodiversity in response to beaver modifications are frequently reported. It is often suggested that the key drivers of this change are increases in vegetation structure complexity and the expansion of wetland area. Although these factors are widely acknowledged to be the main mechanisms of increasing biodiversity, there is very little quantitative description of the structural transitions of vegetation and wetland morphology in beaver landscapes. This increase in landscape/vegetation structural heterogeneity is also key in terms of hydrological regime change. Beaver wetlands store water, reducing fluctuations in streamflow by attenuating storm flows and maintaining baseflows during periods of low rainfall. A better understanding of how landscape structure affects hydrology in these landscapes is key for understanding future catchment-scale impacts of beaver reintroductions on water resources.

In this study we quantified the structural changes that result from new beaver activity, across a 3 ha wet woodland site in Devon, UK, which had not previously been colonised by beaver. The site is composed of scrub, rough grassland and wet woodland. Vegetation structure was measured during both summer and winter to determine interannual and intra-annual change. Aerial imagery has been captured, at three month intervals, using a digital camera (Ricoh GR II) mounted to a lightweight quadcopter (3DR Iris). SFM was used to create 3D point clouds and orthomosaics of the site with a view to quantifying changes in canopy structure and wetland extent. Since beavers are known for their ability to modify their habitats over short timescales, it was necessary to embrace an efficient workflow to expedite data processing. This was achieved by installing a network of permanent ground control markers, whose location in 3D space was established using a high accuracy DGNSS system, facilitating regular repeat surveys and improving reproducibility between surveys. The site was surveyed with two flight paths, one at a mean height of 55 m (nadir camera positioning) and the second at 60 m (convergent positioning), with both flights obtaining forward and side image overlap of 77% and 70%, respectively. Five surveys have been carried out over a 1 year period (one prior to beaver occupancy). Mean ground resolution for pre-processed imagery was 1.5 cm/pixel, and mean errors of models for independent check markers were (xy) 8.4 cm, (z) 7.4 cm.

A comparison of summer canopy heights prior to beaver occupancy and one year after was carried out by converting point clouds to rasterised canopy height models and creating a digital elevation model of difference. Mean canopy height, over a core area of 1.5ha around the beaver lodge, decreased by 2.0m $\pm$ 1.6 (SD) with a maximum reduction of 9.6m where large trees had been felled. Eight additional flights are proposed over the next 2 years to capture further change. We anticipate a continued expansion of the wetland area and an increase in the heterogeneity of the canopy height as the ecosystem continues to be modified by beaver activity.