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Predicting the expansion and impact of the Eurasian Beaver (*Castor fiber*) at catchment scales.

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The Eurasian Beaver is an ecosystem engineer due to its ability to modify waterbodies and the surrounding riparian area via the construction of dams, felling of trees, channel excavation and bank burrowing. The resulting wetland systems provide valuable habitat for other species which in turn increases biodiversity. Beaver wetlands can provide a range of ecosystem services including the attenuation of flood flows downstream, the increase of baseflow, the capture of fine sediment and the storage of pollutants. Beavers can also present a potential management concern where they cause damage to property, land or critical infrastructure as a result of their engineering activities.

In order to predict the potential extent of these impacts beyond the trial period, a range of models have been developed to predict (i) dam capacity, (ii) risk of management conflict and (iii) territory/population capacity of the catchment.

1. A Beaver dam capacity model was developed by adapting and extending the techniques developed by Macfarlane, et al. (2015) for the Beaver Restoration Assessment Tool (BRAT) into a UK-specific version of the model. This model evaluates the reach-based dam capacity (in dams per kilometre) across an entire catchment using a rules based fuzzy inference system. Model validation was undertaken in a range of river systems, with both fenced and unfenced Beaver populations, in Devon, Cornwall and Perthshire. The model was able to accurately predict dam density in locations where damming activity had already occurred.

2. Using the dam capacity output, a valley bottom extraction tool (Gilbert, et al. 2016) and a conflict-index for surrounding landuse, a model was developed that identifies areas within a catchment that could experience conflict with beaver because of dam construction. The model uses a fuzzy inference system across a rasterised grid of the valley bottom to determine local risk at a 5m spatial resolution.

3. Dam capacity and reach-averaged vegetation quality were used to build a model that can predict the maximum beaver territory capacity at catchment scales. This was achieved using a logical comparison of theoretical territory areas for every reach (200m) in a catchment. Those more suitable territories are located and compared with others that overlap it, inferior overlapping territories are deleted. The model has allowed us to make predictions regarding the maximum territory density within the catchment and therefore, using empirical observations from other studies on territory group size, estimate the Beaver population capacity for UK catchments for the first time.

Since their population declines in the late 1600s, both Beaver species, *C.fiber* and *C.canadensis,* have expanded their populations over Europe and North America respectively. These models enhance our understanding of possible future impacts by explaining population dynamics and the management implications of beaver reintroduction. Modelling is a key step for informing management practices so that beaver impacts may be mitigated whilst enhancing/targeting their benefits. These models also provide a critical step for developing new models that describe the potential spatial extent of ecosystem service provision.