Quantifying adjustments in assemblages of geomorphic units to understand geomorphic river recovery across a spectrum of river types and aid recovery detection by river managers

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ABSTRACT

River recovery is defined as the trajectory of change that a reach takes towards an improved condition. In geomorphic terms, this includes improvement in both the physical structure and function of a river. While there are numerous case studies that track river recovery at the reach scale, there is a lack of work that characterises the patterns of recovery across diverse river types. Here we use ergodic reasoning to quantitatively analyse changes in the assemblage of geomorphic units (GUs) that occur for rivers that are known to be at different stages of geomorphic recovery. We aim to understand how the physical structure of different river types changes as recovery occurs. In this study, we have developed a more advanced methodology for semi-automating the mapping of geomorphic units using Open Access LiDAR and Sentinel remote sensing imagery. We analyse the assemblages of GUs for 78 river sections that span eight river types (River Styles), three valley settings and two bed material textures – sand and gravel. We find that confined and laterally unconfined rivers exhibit increased richness, abundance, evenness, and diversity of GUs during recovery, whereas partly confined rivers show more variable trends for these measures. During recovery, sand bed rivers are more susceptible to adjustment than gravel bed rivers. The presence of benches and islands indicates that recovery is underway across most river types. The statistically significant increase in abundance and area of benches, pools and decrease in abundance and area of floodplain steps can also be used to indicate that recovery is underway. Additionally, as recovery occurs, we observe that bank-attached bars tend to become more compound in structure. Determining the indicator GUs and changes in assemblages to 'look out for' in the field or on remote sensing images can aid river practitioners in their detection and analysis of river recovery, providing invaluable insight for nature-based and recovery-enhancement approaches to river management.