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Identifying Possible Locations to Study the Chronology of River Terrace Formation in the Scottish Highlands

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River terraces are sections of floodplains that are abandoned as the height of the river lowers, cutting through the riverbed over time. Terrace formation is controlled by multiple factors including climate and river shape (Vandenberghe, 2003).Thus, visible terraces along a modern river are clues to the fluvial and climatic history of the area. The connections between terrace formation and climatic shifts specifically, such a glacial to post-glacial transition, are of primary interest to this project. As a landscape transitions from a cold (or glacial) period to a warm (or post-glacial) climate and vice versa, river shapes and patterns shift in several ways which can initiate a cycle of terrace formation (Vandenberghe, 2003, 2008; Lewin and Macklin, 2003; Werritty and Leys, 2001).

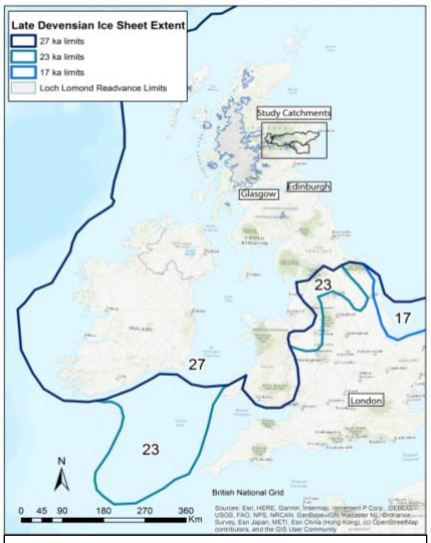

Figure 1: The last ice sheet limits across the United Kingdom (BRITICE Glacial Map). The Loch Lomond Readvance was an areally small series of glaciers in the mountains (~13,000-11,700 years BP) (Ballantyne, 2019). ArcMap, version 10.7.

There are several theories relating terrace formation to climate, however, the theories do not address the size and timescales of climatic shifts needed to induce a shift in river patterns and initiate terrace formation (Vandenberghe, 2008). Key research questions thus include: What magnitude of climatic shift is needed to cause modifications to river patterns? Once a climatic shift has caused a river to change, how long does that period last? To address these questions, we aim to establish a detailed chronology of river terrace formation at several locations in the Scottish Highlands using several dating methods. Scotland has experienced a series of climatic shifts over the past 18,000 years including glacial periods, deglaciations, warming periods, and intermittent cooling and flooding events; this history makes Scotland an ideal place to study post-glacial environments (Figure 1). Before completing field work, however, specific rivers within Scotland with preserved terrace levels that could be used to study these questions, had to be selected. This was my main goal this summer and my main contribution to the project.

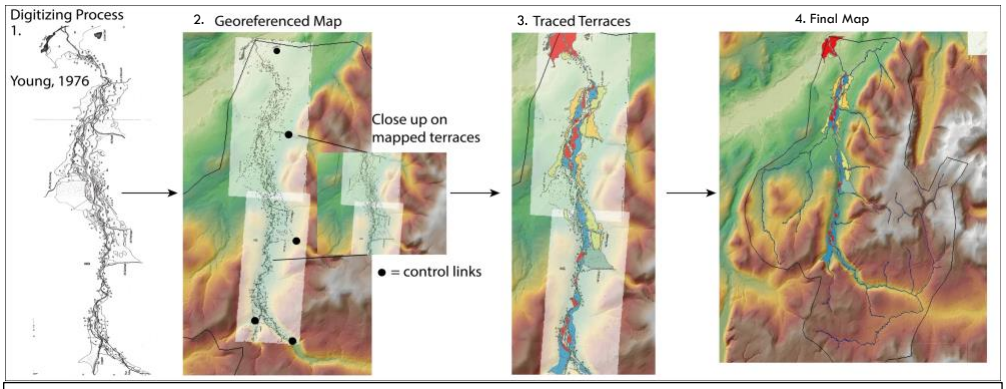

Figure 2: Digitizing Process schematic of Maps and Field Sketches from a 1976 map of Glen Feshie terraces (Young, 1976). The control links digitally pin the original map onto the DEM in ArcMap, this gives the original map a spatial reference. Once the original map is in the right location and orientation the terraces were traced. ArcMap, 10.7.

To accomplish this, I used information acquired from articles documenting Scottish terrace sequences to create summary tables and ultimately make maps of the top three locations using a GIS software called ArcMap (Figure 2). I rejected multiple locations mostly because of ambiguity in the scientific literature and a lack of field maps or sketches. Advantageous terrace sequences were well documented, sketched or mapped, and consisted of multiple levels. I ultimately identified three locations, Glen Feshie, Glen Dee, and River North Esk, all in eastern Scotland as possible locations to carry out future field work. For each site I made a series of maps which will help inform field work strategies. At each location, we would sample sediment from the terraces to analyze and determine the timing of formation to test our hypotheses relating climatic events to changes in river patterns and the development of terrace sequences.

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