Least Disturbed Rivers in the Altai Mountains: A Case Study from the Biya River

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Abstract Anthropogenic stressors have altered the hydromorphological characteristics of rivers worldwide. Environmental guiding principles are essential for the planning of sustainable river restoration measures. This study aims to elaborate such guidelines and to support process understanding. The alpine river Biya (RU) represents a least disturbed hydromorphological reference system. Planform hydromorphological patterns for selected reaches along the Biya will be analyzed. The obtained characteristics will be discussed alongside historical maps of comparable rivers in the European Alps to demonstrate that the obtained dataset can support the planning process of restoration measures there.

Keywords: hydromorphology, sinuosity, reference conditions, alpine rivers.

Methods

The river net of the Biya system was processed based on the ASTER v3.0 data set provided by the NASA using the software ArcMap 10.7.1. In a first step, the planform river geometry was assessed based on the parameter of sinuosity (Mueller, 1968). Sinuosity along the river Biya was calculated for sub-stretches with a length of 10, 5 and 1km. This represents one example of the proposed set of hydromorphological parameters that will be derived from the Biya data set. The derived data was compared with sinuosity values from the Austrian river Traun in both its current state ("Gesamtgewässernetz") and a historic situation (based on "Josephinische Landesaufnahme", 1775-1777).

Figure 1: The Biya river close to its origin at the outflow of Lake Teletskoye (RU). (Photo: Martin Schletterer)

Preliminary Results

Sinuosity values for 5km sub-stretches along the Biya river were higher on average (1.20), than along the Traun, both in its current (1.14) and the selected historical situation (1.16). The majority of observed stretches lie in the range of what is often described as "sinuous" channel morphology (Morisawa, 1985).

The Sinuosity values for the Biya river show a higher variability, including upwards outliers, than both data sets from the Traun. This is in line with the expectation, that the Biya river is a hydromorphologically intact system. The Traun, in its historical state, shows slightly higher Sinuosity values, than today. This might be a result of river straightening measures.

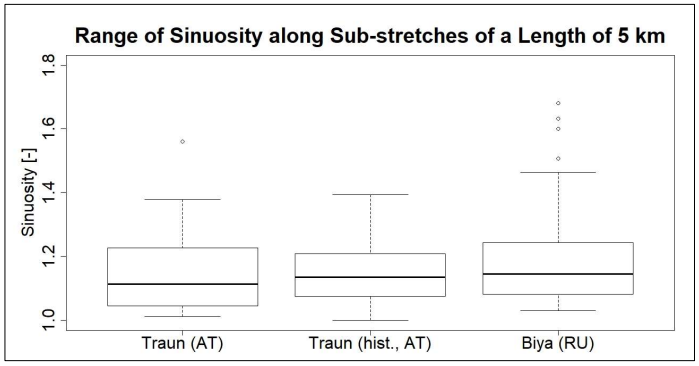

Figure 2: Comparison of Sinuosity values from the Biya (RU) and the Traun (AT, in current and historical situation) for sub-stretches of 5km length.

Outlook

Research suggests that channel (planform) geometry and topographic parameters (Ferrer-Bolx et al., 2016, Pitlick and Cress, 2002). Further steps will include a closer investigation of the relationships between channel sinuosity and variations in channel width along the Biya river.

The proposed study will also provide an example of the application of the proposed guiding priciples for an anthropogenically impacted Alpine river.

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