Tracking Large Woody Debris in a Low-Energy Meandering River
Embarras River, Illinois

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Introduction

Previous research on large woody debris (LWD) has focused largely on its impact on flow structure and bed morphology in high-energy mountain streams, rivers within old-growth forests, or where logging has been a land use practice within the watershed (Keller and Swanson, 1979; Abbe and Montgomery, 1996). Few studies have investigated LWD in low-energy meandering river systems, such as in the Midwestern USA, where extensive land use change and clearing occurred over a century ago (Daniels and Rhoads, 2004). The purpose of this investigation is to track inputs and outputs of wood at a LWD accumulation on the Embarras River in east central Illinois. LWD has collected at the entrance of a meander bend chute cutoff and may be a factor that has prevented capture of the main flow through the cutoff channel. Knowledge of the stability of this LWD may provide insight to the dynamics and evolution of this meander bend.

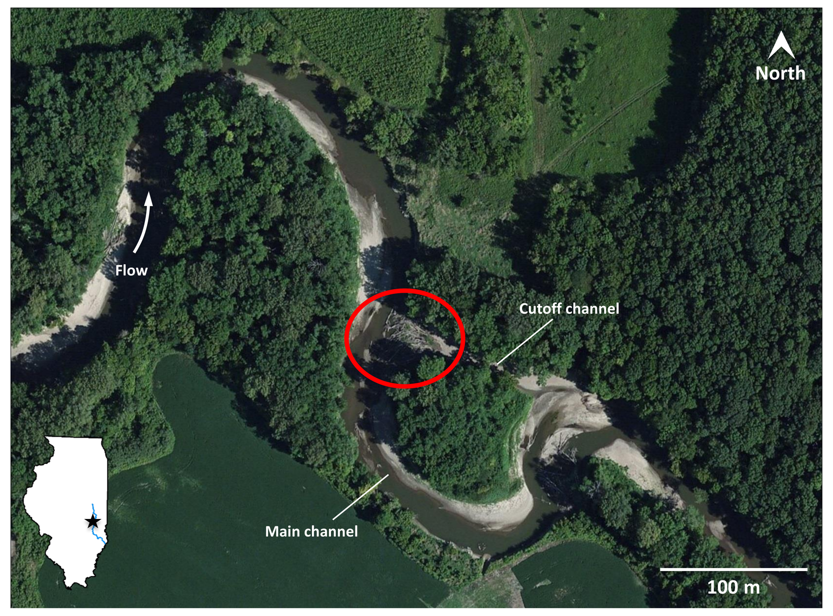


Figure 1. Aerial photo of the study site. The red oval indicates the position of the LWD. Star on inset map shows the location of the LWD on the Embarras River in east central Illinois.

Field Site

The field site for the research is located at the entrance of a meander bend chute cutoff on the Embarras River, approximately 5 km south of Charleston, Illinois (Figure 1). The Embarras River is a low-gradient tributary of the Wabash River. The field site lies within the Shelbyville Morainic System, a terminal moraine deposited during the Wisconsin Glacial Episode, and drains 2,308 km^2 of till plains that are today used predominantly for agriculture. LWD has accumulated at the downstream corner of the entrance of the cutoff channel and extends across much of it, covering approximately 850 m^2. The current LWD pile began to develop in 2007, although historical aerial photographs and comments from a long-term landowner indicate past occurrences of LWD breakup and accumulation at this location.

Methods

The first part of the project involves air photo interpretation of existing imagery. Historical aerial photographs of the study site were obtained and recent high-resolution images were used to evaluate the stability of the LWD (Figure 2). The second component of this research is to examine the use of close-range remote sensing and photogrammetry techniques to produce our own orthophotograph and model of the LWD. Recent work (e.g., Fonstad et al., 2013) has shown the utility of such techniques for geomorphic applications. In this study, a Canon PowerShot SX260 HS camera was mounted on a pole at a height of 5.2 m and angled toward the ground. An internal intervalometer was used to collect a series of 130 overlapping photographs of the LWD with the pole camera (Figure 3), in addition to numerous ground photos. 14 ground control points were distributed across the LWD from which geographic coordinates were obtained with a Leica Viva GS12 GPS. Agisoft PhotoScan software was used to process the photos to generate an orthophoto and 3D spatial data of the LWD.

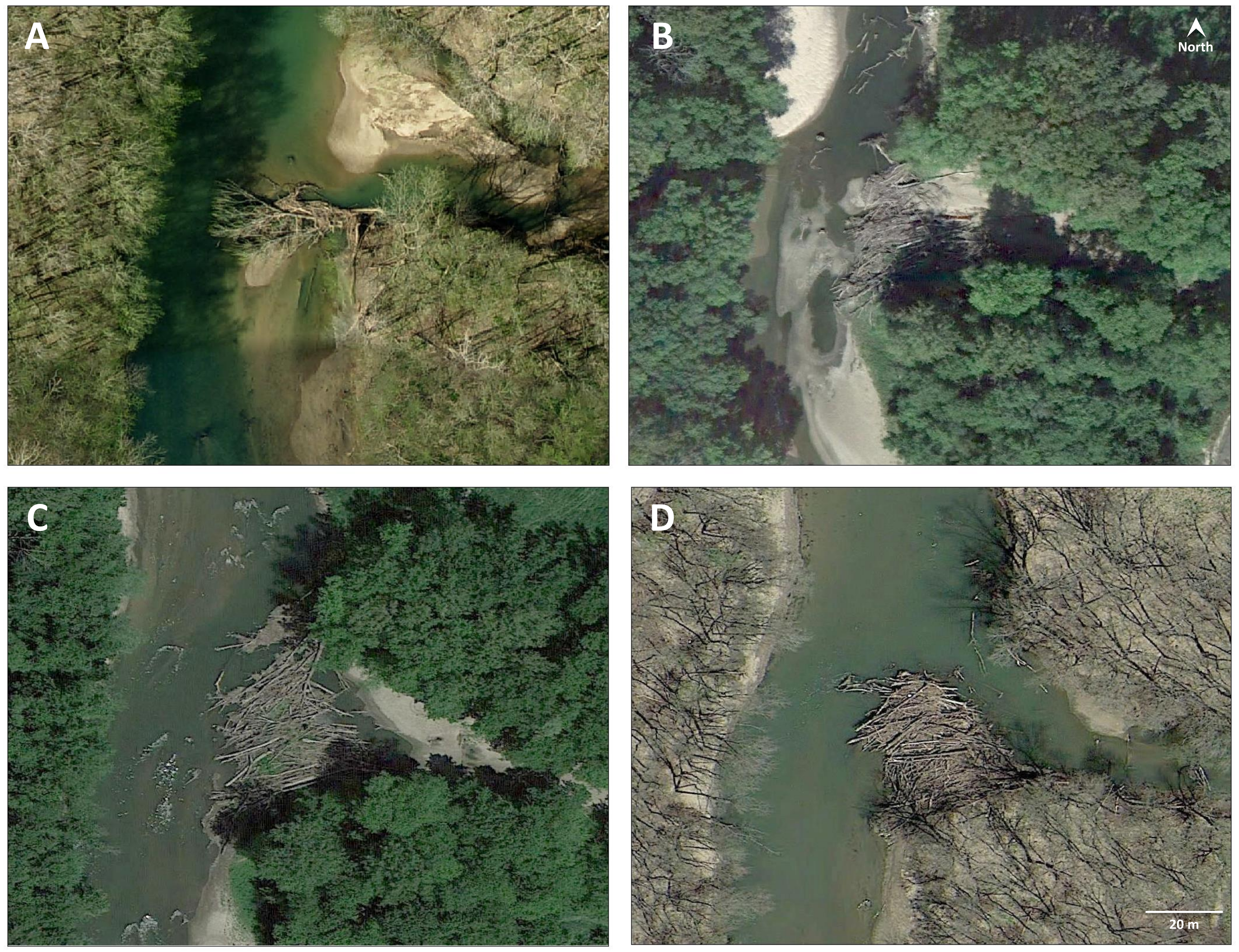


Figure 3 (above). Jessica using the pole camera to capture photos of the LWD on February 13, 2015.

Figure 2 (left). Aerial photographs of the LWD: (A) spring 2007, (B) October 4, 2010, (C) May 16, 2012, and (D) April 18, 2014.

Results

The current accumulation of LWD began to develop in spring 2007 when a small bank failure at the downstream end of the entrance of the cutoff channel caused a tree to fall into the main channel, perpendicular to the direction of flow (Figure 2). The trunk and rootwad of this key member collected numerous logs oriented both orthogonally and obliquely to the flow, similar to the construction of bar apex jams described by Abbe and Montgomery (1996). The shallowness of the main channel likely contributes to the preferential deposition of debris at this location due to a bar complex that extends across most of the entrance to the cutoff channel toward the upstream end of the point bar. The pile grew between 2007 and 2010 and has since remained stable. Numerous high-discharge and flood events have occurred on the

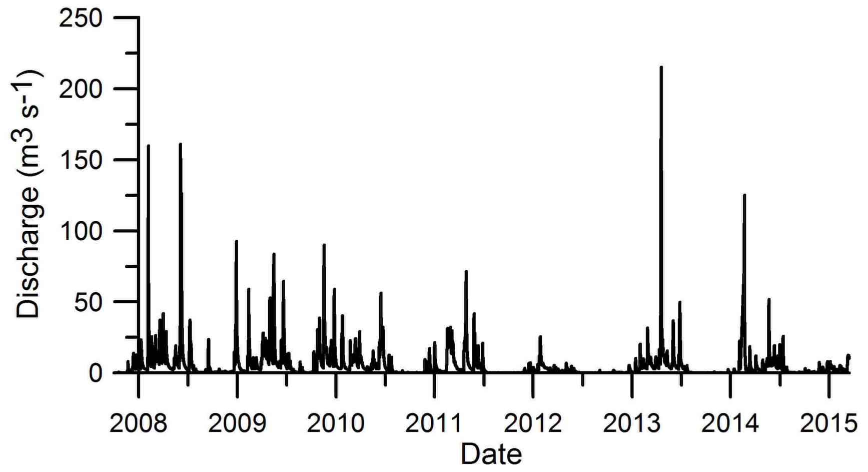
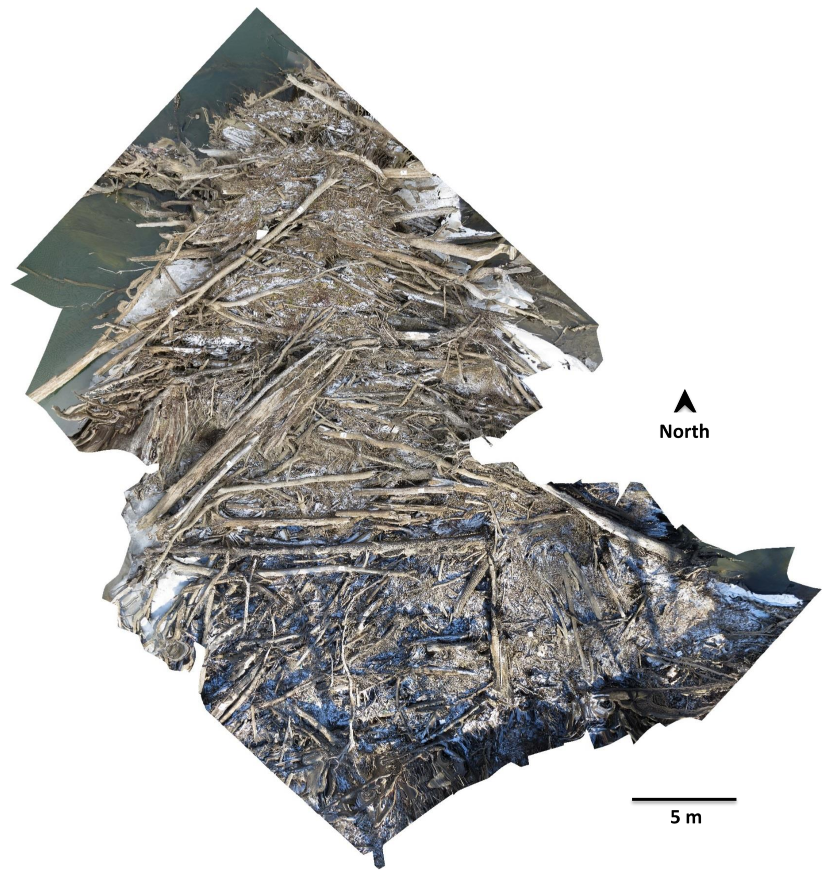


Figure 4. Hydrograph for USGS 03343400 Embarras River near Camargo, IL. This gage is located 82 km upstream of the study site, but is the nearest gage in operation and is included to provide hydrologic context.

Figure 5. Orthophoto produced from pole camera photography of the LWD on February 13, 2015. Distortion and warping exist in the photo, especially along the margins, but the resolution is impressive and the technique is a promising means to track inputs and outputs of wood to the pile over the long term.



Embarras River since the LWD began accumulating (Figure 4), but none have flushed portions of the pile downstream.

Little change in the LWD occurred between April 18, 2014 and February 13, 2015 – the orientation of most of the logs remained the same (Figure 5). This is expected as there was only one large discharge event over this time period. The similarity between these photos is actually beneficial to evaluate the effectiveness of the photogrammetric methods. Field work at the site also revealed the verticality and layered appearance of the LWD. The stability of the LWD structure may serve as an important control on the evolution of this bend and its chute cutoff.

Future work will focus on 1) improving the quality of orthophotos and models and 2) monitoring changes in the LWD in relation to hydrologic events.

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