Salmonid and macroinvertebrate responses to engineered large wooded debris structures in a low gradient UK upland stream

September 2014

Large wooded debris (LWD) has been shown to be an important habitat factor in lotic ecosystems. By altering the local hydromorphology, stream bed stability and detritus availability, LWD can change the river habitat and therefore alter the distribution on fish and macroinvertebrates within the environment.

This study aimed to find what effect LWD built into the river bed (Figure 1) would have on fish and macroinvertebrate populations in an upland low gradient stream, where deforestation has led to low volumes of organic detritus and logs entering the river system.

Figure 1. Large wooded debris (LWD) installed in the River Cover. *Photo: Sarah Usher*

Impact of LWD on river ecology

Ten sites on the River Cover in the Yorkshire Dales were chosen due to their similarities in width and flow.

Five sites acted as control sites (unchanged) and five sites were used as 'before – after' study sites where LWD structures were introduced.

Stage gauges with 15 minute data loggers were placed at the bottom of the upper and lower sections to record water level variations.

Oak structures were built into the centre river bed at each of the 5 study sites forming T-apex jams to mimic fallen trees with root boles. All structures were similar in size and structural complexity.

Kick sampling for macroinvertebrates was carried out at all ten sites before the LWD structures were installed. One month after the start of the study, sampling was repeated taking into account both control sites and the area around the LWD structures. Macroinvertebrates were identified to species level.

The project quantified the populations of brown trout (*Salmo trutta*) and macroinvertebrates before and after large wooded debris (LWD) installation.

Figure 2. Brown trout in the River Cover were captured and released at each site.
Photo: Sarah Usher

Brown trout populations were calculated using a portable backpack electric fishing kit, following the three stage depletion methodology.

This was carried out over several days before wood installation, and during similar flow conditions one month after LWD installation. Fish were measured to fork length.

The research described here is based on a study completed by Sarah Usher for her MSc in River Basin Dynamics and Management with GIS at the University of Leeds. Sarah's work was supported by her supervisor Dr Lee Brown, the Yorkshire Dales Rivers Trust and JBA Consulting's Saltaire office.

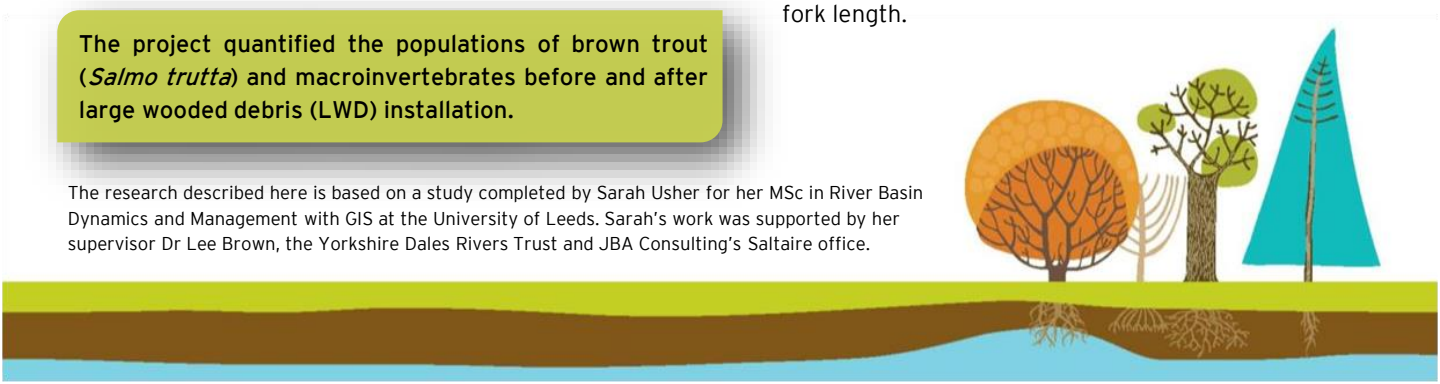

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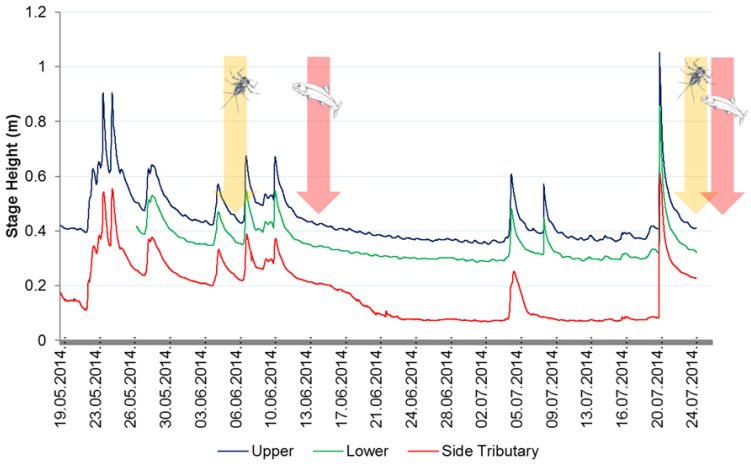
Figure 3. River Cover stage height 19/05/2014 - 24/07/2014.



Macroinvertebrate sampling took place as indicated by orange arrow, electric fishing is indicated by red arrows.

The data loggers indicated that a high flow event occurred between the initial and post-installation surveys (Figure 3), which is likely to be attributable for the geomorphological changed observed within the short time frame shown in Figure 4.

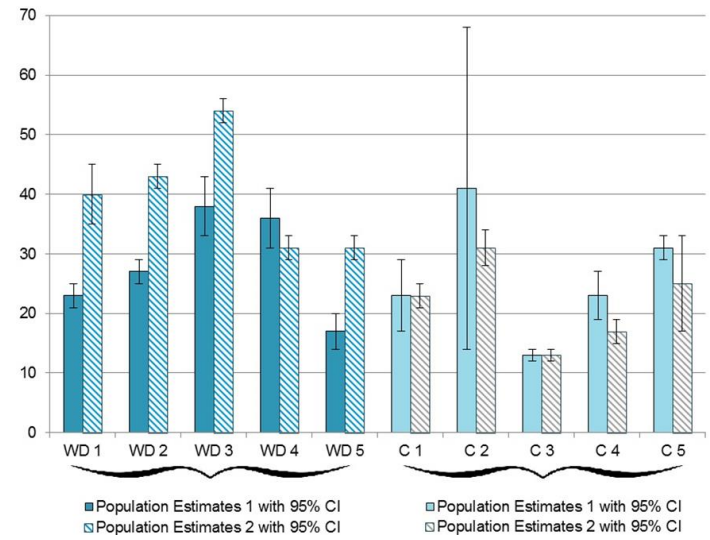


Figure 5. Population estimates at wooded debris sites (WD) and control sites (C) pre (1) and post (2) installation

The results show that LWD structures have created a more diverse habitat, leading to higher abundance of brown trout at the wooded sites and improved macroinvertebrate diversity.

Observed changes could be attributable to a number of factors, including displacement and relocation during the high flow event preceding the Phase 2 survey, temporal variance and hydro-geomorphological changes around the LWD.

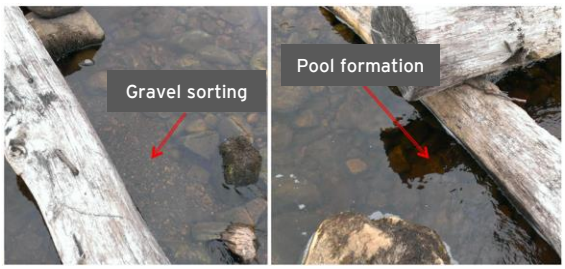


Figure 4. Geomorphological changes following installation of LWD. *Photos: Sarah Usher*

Further research over longer timescales is needed to overcome temporal variation in habitat preference.

Modelling the hydrodynamic effects occurring around the LWD structures could help determine the specific aspects of the structures that support the provision of suitable fish habitats.

Fish lengths showed a bimodal distribution due to the differences in parr ages (0 yr and + 1 yr).

There was a significant change in the distribution of fish of different lengths at the LWD sites but not the control sites ($p < 0.01$).

Fish population estimates were calculated and it was found that there was an increase in population estimates at the LWD sites ($p = 0.05$) compared with the C sites (Figure 5).

Changes in the fish population distribution between the control and WD sites is thought to be most attributable to the shading and shelter effects of the LWD. Due to life-stage specific preference of brown trout, this effect would be better observed over a full year cycle.