SILTATION II

Quantification and management of erosion and siltation

PROJECT TEAM
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COMPLETION DATE
July 2007

OBJECTIVES
To analyse the effects of forest clearfelling and harvesting operations on:

- the suspended sediment and phosphorus concentrations in a peat catchment drainage stream.
- other biological and physico-chemical parameters, e.g. pH and temperature in the catchment drainage stream.
- the hydrology of a stream draining a blanket-peat catchment.

PROGRESS
The project finished in July 2007. The final report has been submitted to COFORD and the EPA. The clearfelling and extraction operations in the Srahrevagh river catchment site (Burrishoole, Co Mayo) employed best management practices, which included not carrying out any field work during wet periods. The operations commenced on 25 July, 2005 and lasted for eight weeks. Two monitoring stations were established, one upstream (US) and the other downstream (DS) of the selected clearfell area, to study the effects of the operations on the hydrology, sediment losses, water phosphorus, water physico-chemical and biological parameters in the first order stream flowing through the blanket peat catchment site. Measurements were taken before clearfelling for about one year, during clearfelling and extraction, and post-clearfelling for about 19 months.

From the present analyses, clearfelling and extraction had very limited impact on flood risk downstream in this study (Figure 1). A similar study of felling has recently been reported from Wales where the site was physically similar to that at the Srahrevagh study site, Burrishoole, with a high annual rainfall (>2,000 mm) and peat soils with open drainage. The impacts on streamflow in the Welsh sites were closely monitored in nested catchments from 1 to 10 km^2 in size. Commercial felling followed the GB Forestry Commission's harvesting guidelines (Forestry Commission 2003). It was found that there was a significant increase in baseflows but a change in peak flows (Robinson and Dupeyrat 2005) was not detected. The similar peak flow result at Burrishoole may be due to the care taken to comply with the Forest Service guidelines (2000 a,b). Taken together, the results of the Welsh and Burrishoole studies, and that of more recent published literature indicate that properly conducted felling can have a very limited impact on flood risk downstream.
In base flow conditions, the suspended sediment (SS) concentrations at the US and DS stations were always low before, during and after clearfelling and extraction (Figure 2). From

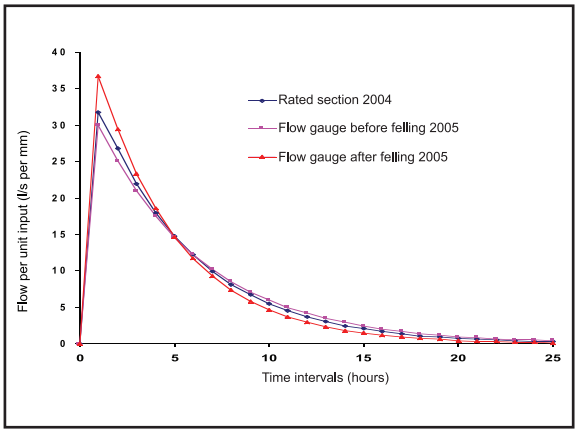

Figure 1: Storm unit hydrographs (one-hour) for the downstream gauge for the periods before felling (rated section and subsequent flow gauge) and after felling.

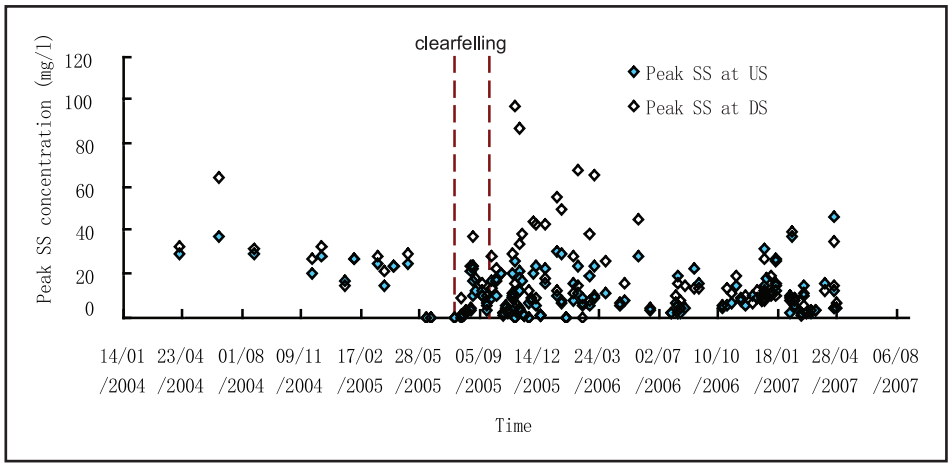

Figure 2: Daily peak suspended solid concentrations at the upstream (US) and (DS) stations during the study period.

November 2005 to April 2006 there were significant differences between the daily peak US and DS concentrations. From May 2006 to May 2007, the SS concentrations at the US and DS stations were similar, indicating that the effect of clearfelling and extraction on SS concentrations in the study stream appears to have ceased (Figure 2). During the clearfelling and extraction period (August and September, 2005), about 13 kg SS/ha were released from the undisturbed forest catchment and 25.8 kg SS/ha from the harvested catchment. In the first year after clearfelling and extraction (2012 mm rainfall), the net SS release rate from the harvested catchment was 272.6 kg SS/ha/year, which was greater than the 172 kg SS/ha/year released from the undisturbed forest catchment.

Measured P concentrations entering the harvested part of the study catchment through the US station were low, with average values of 14 µg TP/l and 6 µg TRP/l. The average P concentrations in the rainfall were 13 µg TP/l and 4 µg TRP/l (Figure 3). The P concentrations rose after clearfelling to a first peak daily average concentration of 187 µg TRP/l in November 2005, and then reduced, with temporal variations, to summer 2006. After a particularly dry spell in June and July 2006, the highest peak daily average concentration of 429 µg TRP/l was measured in August 2006, a year after clearfelling commenced. The daily average P concentration of about 100 µg TRP/l was recorded at the end of April 2007, 19 months after the operations were completed (Figure 3). During the clearfelling and

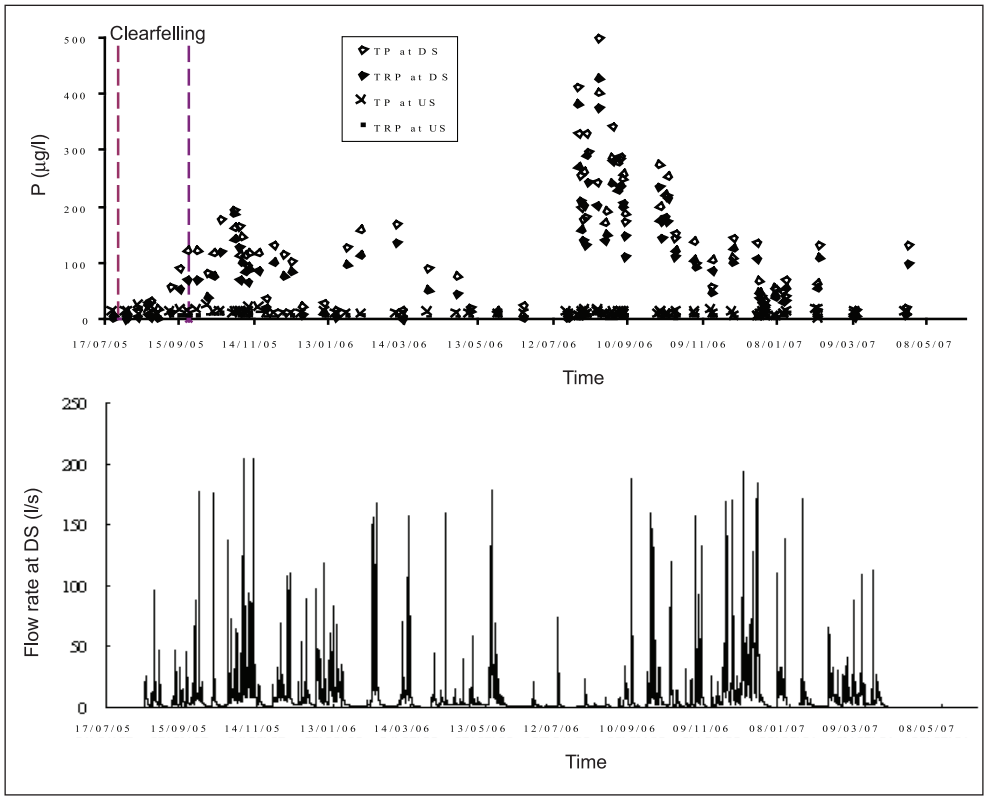

Figure 3: Average daily phosphorus concentrations at the upstream US and downstream DS stations and the flow rate at DS during the study period.

extraction period, an estimated net 120.6 g TRP/ha were released from the harvested area. In the first year after clearfelling - October 2005 to September 2006 - net P load release rates were estimated at 2243.9 g TRP/ha.year from the 10.5 ha harvested site and 20 g TRP/ha.year from the 7.2 ha forested upstream site. Because of the available dilution in the receiving river downstream of the study site - based on the relative sizes of the river and study catchments - phosphorus exiting the clearfelled area only slightly increased the phosphorus concentration in the receiving river. Average concentrations in the receiving river were 5 µg TRP/l above and 9 µg TRP/l below the confluence of the study stream and the river.

The macroinvertebrate survey of the study stream indicated that there had been no significant change in the assemblages following clearfelling (Figure 4). However, in coming to this conclusion, it must be acknowledged that the baseline assemblages (2004 and 2005) were fairly depauperate, comprising only small abundances of acid tolerant species. The plecopteran species, which are very sensitive to eutrophication, appeared to be unaffected by the clearfelling operations. The depauperate assemblages may be due to two factors – the acidification effects of the forest over the last three decades, or the temporal nature of water flow given the size of the stream. Long-term monitoring of this site will be useful in assessing whether the stream is capable of supporting a more diverse and abundant macroinvertebrate fauna without the influence of closed canopy forestry.

ACTIVITIES PLANNED

The project finished in July 2007.

OUTPUTS

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on phosphorus release from soil to water (Submitted to *Journal of Environmental Quality*).

Xiao, L., Rodgers, M. and O'Connor, M. The effect of clearfelling and harvesting operation on suspended sediment release from soil to water. (Ready to be submitted).

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on water quality: a literature review. (Ready to be submitted).

Xiao, L., Rodgers, M. and O'Connor, M. Preliminary model of phosphorus movement from a blanket peat catchment to water in the west of Ireland. (Ready to be submitted).

Rodgers, M., Xiao, L. and O'Connor, M. The effect of clearfelling and harvesting operation on river water temperature and pH. (Ready to be submitted).

Rodgers, M. and Xiao L.W. *Sediment and nutrient load patterns in forested streams*. In: National Technical Workshop for Programme of Measures National Study Forest and Water, Talbot Hotel, Wexford (March 2007).

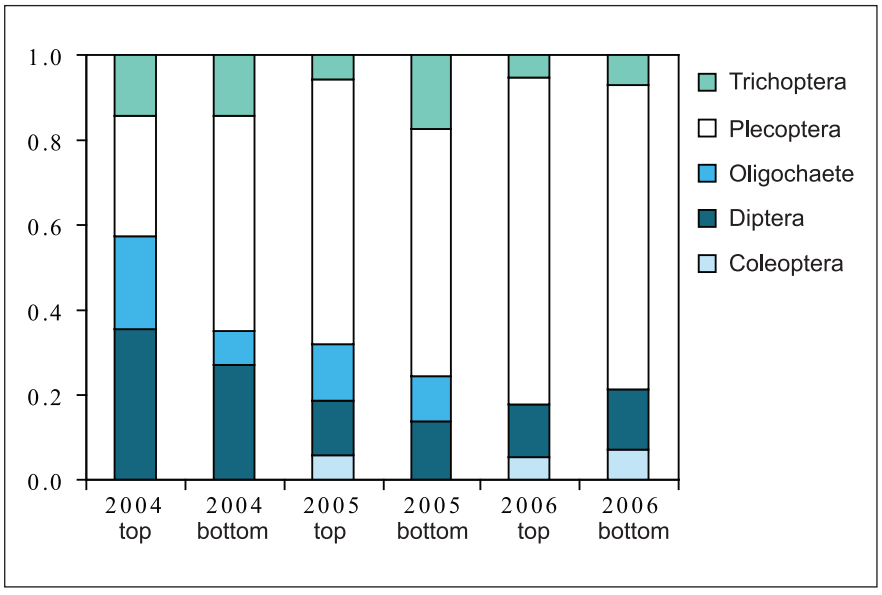

Figure 4: Percentage composition of macroinvertebrate samples taken from two sites of the experimental stream in the Srahrevagh River sub-catchment.