Productive Grazing, Healthy Rivers
Module 2: Wood to Water

R. Lester

Why is wood in streams important?

Wood in streams (woody debris) includes all types of wood from small twigs and leaves to branches and entire tree trunks. Wood is an important component of the in-stream environment as it creates diversity in channel shape and water velocity, providing a variety of conditions suitable for a wide range of organisms. It provides shelter from predators and high flow conditions. It can cause localised deposition of sediment or erosion of the stream bed, resulting in pools that act as a refuge for in-stream organisms during dry conditions.

Wood is also an important food source for organisms such as aquatic macroinvertebrates and provides a hard surface otherwise lacking in streams with sandy or silty substrates. This hard surface creates habitat for macroinvertebrates and a spawning and feeding site for many species of fish.

Streams running through agricultural properties often contain a small quantity of wood relative to streams in forested catchments. Active removal of the wood from channels was a common practice in the past as this wood was thought to contribute to flooding and erosion, to damage infrastructure or simply 'looked untidy'. In addition, extensive clearing of riparian land removed the source of much wood for streams in agricultural land. While many streams have recently been fenced from stock and re-planted, it may take decades for those trees to mature to the point of being a source of in-stream wood.

What did we do?

The aim of this research module was to investigate the effectiveness of artificially re-introducing wood into streams on agricultural properties as a biodiversity enhancement measure. In-stream macroinvertebrates were used as a surrogate for biodiversity, and changes in hydrology and morphology of the streams was monitored to ensure this practice was acceptable to landholders. A method for re-introducing small woody debris into fenced and revegetated riparian areas was developed.

Status of this Module

Complete

This module commenced in August 2003 and forms the doctoral (PhD) thesis research for Rebecca Lester. Data analysis is complete and the thesis is being finalised for submission in October 2006. The data was used to prepare a scientific publication which was accepted. Other publications are currently being prepared.

R. Lester

How?

Study sites

The research was conducted at eight pairs of control and experimental sites across Gippsland and southwest Victoria. Each site was located on a commercial intensively grazed property where the stream had been fenced from stock and re-vegetated in the previous 3 to 7 years. Control and experimental sites were paired according to the similarity of their initial community of in-stream macroinvertebrates. Wood was introduced to the experimental but not the control sites.

Eight reference sites in areas with no history of active wood removal or riparian clearing were also surveyed to provide a benchmark of macroinvertebrate diversity in streams resembling a more natural condition. Reference sites were also used to determine what a 'natural' load of wood was in the relevant study areas.

Surveys

Control and experimental sites were surveyed for macro-invertebrates, habitat quality, water quality, stream morphology and hydrology. Wood was then introduced to experimental streams to mimic the loading found at reference streams. Small pieces of wood (maximum diameter 25 cm) were selected for introduction to minimise damage to the replanted riparian zone and eliminate the need for heavy machinery. Each site was re-surveyed three weeks after the introduction of wood and again after 6 months. Surveys included aquatic macroinvertebrates, habitat quality, water quality, hydrology and erosion. Reference streams were surveyed at the same time as the 6 month round of control and experimental surveys.

Wood introduced at an experimental site.

What did we find?

Was there a need for wood re-introduction?

Reference sites and sites on agricultural properties (control and experimental) were initially compared to determine whether there is a need for re-introduction of wood ie. is there a difference between the macroinvertebrate communities at reference sites compared to those found in streams on agricultural properties? The communities at each site were assessed and the average number of families found at each reference site was significantly higher than the number found at each agricultural site (Table 7).

When the macroinvertebrates at each site were grouped according to the manner in which they feed (functional feeding groups), the reference sites showed a higher average number of each feeding group, with significantly greater numbers of collectors and predators (Table 7). The largest difference observed was amongst the average number of predators.

This suggested that streams in reference condition are more complex, as they are able to support a greater diversity of higher order consumers than streams in agricultural landscapes.

Table 7. Number of families and feeding groups recorded on reference and agricultural sites (mean and 2xSEM).
* Indicates statistically significant difference.

	Reference	Agriculture
No. of families	22.00 ± 2.44*	17.63 ± 15.8
Feeding Group		
Collectors	10.50 ± 1.00*	9.13 ± 1.32
Predators	5.25 ± 2.22*	3.38 ± 1.46
Scrapers	1.50 ± 1.74	1.13 ± 1.10
Shredders	2.00 ± 0.82	1.88 ± 0.96
Unallocated	2.75 ± 2.36	2.13 ± 0.80

Did re-introducing wood make a difference?

Having determined that streams on agricultural properties have fewer families and fewer predators and collectors than streams in reference condition, wood was introduced to the experimental sites on agricultural properties to determine if this was a suitable method for increasing macroinvertebrate communities. Control sites on agricultural land had no wood added.

Control and experimental paired sites were compared prior to the introduction of wood and no significant differences in the average number of families between sites was measured, suggesting that sites were appropriately paired. Following the introduction of wood, significantly more families of in-stream macroinvertebrates were present at experimental sites than before the wood was added, while no difference was observed at control sites (Figure 6).

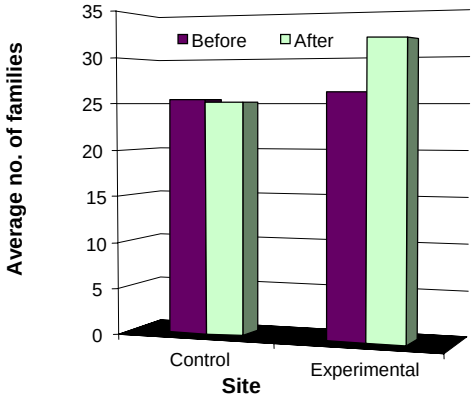

Figure 6. Average number of families detected before and after wood introduction at control and experimental sites.

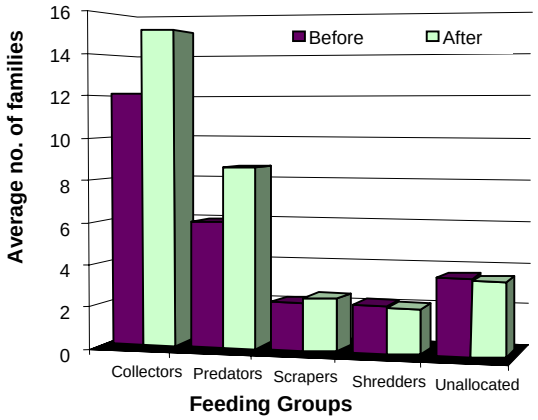

Figure 7. Comparison of functional feeding groups found at experimental sites before and after introduction of wood.

When macroinvertebrate families were examined by functional feeding group, significantly higher numbers of predators and collectors were found at the experimental sites after the introduction of wood (Figure 7). There was no corresponding increase in any functional feeding group at control sites.

Another common method of investigating the macroinvertebrates detected in streams is to examine the families considered sensitive to environmental degradation, or the EPT taxa (families belonging to the orders Ephemeroptera, Plecoptera and Trichoptera).

Prior to the introduction of wood, no significant difference in EPT families was observed between control and experimental sites. Following introduction, a significantly higher number of EPT families were detected at experimental sites where wood was added to the stream (Table 8).

Table 8. Average number of sensitive families detected at control and experimental sites (mean and 2xSEM).

EPT families	Control	Experimental
Before Wood	5.25 ± 3.42	5.75 ± 3.00
After Wood	6.38 ± 3.38	8.63 ± 3.72

One of the traditional reasons for removing wood from streams was the belief that wood was responsible for erosion. The addition of wood at experimental sites in this study did not cause additional erosion, with no significant difference observed between the erosion rates at either control or experimental sites.

Do the macroinvertebrate communities at experimental sites resemble reference sites?

Adding wood to streams in an agricultural landscape increased the diversity of the macroinvertebrate community, but was this change an improvement?

No difference was detected between the average number of families at experimental streams on agricultural land where wood was introduced compared to reference streams. In contrast, the average number of families observed at control agricultural streams was significantly fewer than that found at reference streams. This indicates that adding wood was able to redress the lack of families detected at streams in an agricultural landscape, making them more similar to streams in reference condition (Figure 8).

Analysis of the functional feeding groups at experimental streams showed no significant difference between the number of collectors and predators found, however, significantly fewer shredders were found at experimental sites. Further examination suggested that shredders were slower to respond to changes in the stream environment than other types of feeders, and may need more time to adjust after the addition of wood.

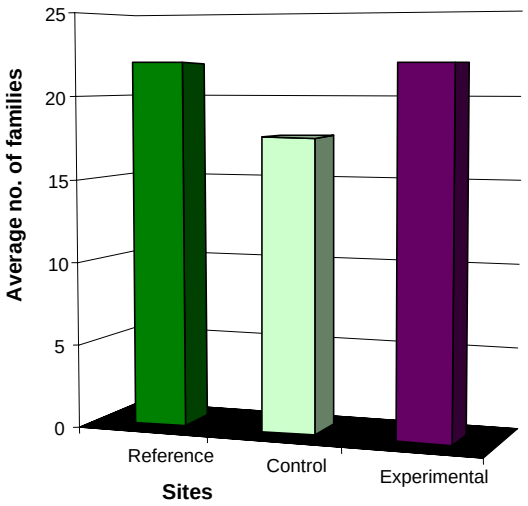

Figure 8. Comparison of average number of families found at reference, control and experimental agricultural streams.

Control Site - Settlers Creek.

Experimental Site - Settlers Creek.

Reference Site - Parker River.

What does it mean?

- Some of the differences seen in the macroinvertebrate diversity of agricultural streams and streams in reference condition are likely to be due to the lack of wood in agricultural streams.
- Adding wood to streams on agricultural properties:
  - **Increases** the habitat complexity
  - **Increases** the average number of macroinvertebrate families
  - **Increases** the average number of collector and predator feeding groups
  - **Increases** the average number of pollution sensitive families (EPT taxa).
- Adding wood to streams as a rehabilitation measure for agricultural streams creates a macroinvertebrate community more similar to the reference streams.
- Streams in agricultural landscapes have fewer families and fewer families of predators and collectors than streams in reference condition.
- Increasing the number and type of macroinvertebrates will increase the food supply available to higher order consumers, while the increased diversity of habitat could also be utilised by other taxa.

How to place wood back into your stream

1. Where possible, use locally indigenous species.
2. Use wood that would otherwise go to waste (eg. burnt). Try not to remove it from the streamside or other vegetation patches on the farm, as logs and fallen branches are important components of the terrestrial habitat as well. Potential sources may include thinning of replantings or waste from council prunings.
3. Use a variety of shapes and sizes of branches and roots; the more complex the better.
4. Arrange some of the wood in clumps and some in single pieces - approx 13 branches of wood for every 10m of stream was used in this study.
5. Place the wood on the bank at the edge of the stream, approximately half covered with water when at low flow.
6. Wood can be attached to star pickets using nylon string to prevent it from washing downstream. In this study this was effective, even in large floods. Note: Downstream movement of wood is a natural process and may be acceptable when there is no infrastructure immediately downstream that may be damaged.
7. An occasional check to make sure everything is still there and that there is no localised erosion is a good idea.
8. Let the wood do its job. Hopefully, it will attract new species of bugs, fish and frogs to the area, if there are no major water quality problems in the catchment.