STREAM ECOLOGY

Why is wood important in streams?

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Wood in streams isn't debris: it plays an important role in shaping stream channels and providing diverse habitat for stream life.

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This article is about the wood – branches, logs, and entire trees – that ends up in or around streams.

Why wood? Isn't it mainly a problem in water? Logs carried downstream in a flood can wipe out culverts and bridges; in lakes and rivers, boaters must constantly look out for dangerous obstacles – such as tree trunks – lurking just below the surface.

Nevertheless, numerous studies throughout the world have found that wood is an integral part of stream ecosystems and is also important in lakes, large rivers, estuaries, and even the open ocean. This shouldn't be surprising since trees have been growing around – and therefore falling into – water for over 360 million years.

Wood in streams can directly affect the stream channel, and can indirectly influence the availability of food and habitat for many organisms that live in and around the stream. Since forests still cover around 40% of the ice-free land on Earth, answering the "why wood?" question is important for managing streams throughout the world.

Wood and stream channels

The most obvious effects of wood in streams are physical: wood can change channel shape, sediment storage, and the path of water flow. Wood that is large enough to be fairly immobile during floods can have a tremendous influence on the stream. For example, wood can form different types of pools. A log that falls across the channel can create a "dammed pool" upstream of it and a "plunge pool" below it. When a log lies parallel to the flow, the streambed may be eroded in front of the log forming a "lateral scour pool". Sometimes logs divert the mainstream flow from one side of the channel, forming a "backwater pool".

Large wood has other physical effects. Wood can divert stream flow into a bank, causing undercutting and stream widening. Conversely, wood lying alongside and parallel to the bank will prevent bank erosion. Wood can also shift a stream from one side of the valley to the other, change a single-thread channel into a multi-thread channel, divert the flow from the main channel to a side channel, and even force the stream to cut a new channel around it.

Wood also influences the deposition patterns of sediments in streams. Stream flow may be forced to go around, over, under, or along a piece of wood, resulting in a range of water velocities. Fine sediments will accumulate where the water velocity is least (such as in backwater pools), and only coarse sediment remains in faster flows.

Wood and stream life

Wood's influence on channel form increases the amount and diversity of habitats for aquatic organisms. For example, fish use logjams as a refuge from predators, or during a big flood. Some aquatic insects attach to large wood in order to feed, pupate, or lay eggs; this is especially important in streams where other stable substrates, such as boulders, are rare.

Most stream organisms don't actually eat wood, but it can have a major influence on food availability. Leaves and small twigs that fall into the stream are an important food source for microbes and many species of aquatic invertebrates. Wood in the stream channel helps to trap these small fragments

The "plunge pool", located immediately downstream of this log, was formed by the erosive force of the small waterfall on the streambed. (Venture Creek, South Westland)

and prevents their being flushed away quickly. Large, stable logs trap smaller pieces of wood, which in turn, capture even smaller leaves and twigs. For example, in one USA study 75% of the organic matter stored in a small stream was associated with large wood.

Benefits from above the water

Some logs in streams do it all – trap sediment, retain organic matter, create pools, and divert flow to form a bank undercut at one end while armouring the bank at the other end. Other pieces of wood appear to do nothing useful at all. For example, a tree that falls and is suspended across the channel might be considered to have no aquatic function. However, logs suspended above the channel can be colonised by a variety of plants, creating a lush ecosystem above the water. Plant material from this suspended community, when it falls, contributes organic matter to the stream. And, eventually, that suspended log will enter the stream.

Wood – not debris!

Logs in streams are often referred to as "large woody debris". It is ironic that something so integral to the health of a stream would be given a name that suggests it is useless garbage that should be removed.

When first used, the term "large woody debris" did refer to a waste product, namely the larger branches and limbs left at a forest harvest site after the merchantable logs were removed. Some of the earliest studies of wood in streams compared natural wood abundances with the amounts placed in the stream through timber harvest. Perhaps it is from these early studies that the term large woody debris was also applied to wood that falls into a stream naturally. We hope this article helps clear the name of an important component of forest streams all over the world. This stuff may be large, and it may be made of wood, but it is certainly not debris! ■

top: Sediment, large wood, and small organic matter have accumulated behind the log being measured. (Bishops Folly Creek, South Westland)

bottom: The large log on the left of this picture forces the stream to flow around it preventing bank erosion. (Whakakai Stream, near Whatawhata, North Island)

NIWA research on wood in streams

We have recently started a pilot study on large wood in New Zealand's native forest streams. We are measuring the amount of wood in streams in different kinds of native forest and in different climates / hydrological conditions, identifying the influences of wood pieces on channel form and on stream food resources.

These surveys of wood in stream channels are augmented by surveys of trees in the forests adjacent to streams. An interesting preliminary finding is that the wood supplied by native conifers and broadleaf trees in New Zealand streams is often augmented by tree ferns – not surprising, considering New Zealand has the loftiest tree ferns in the world!

Once we have defined how the amount of wood varies by forest type and geographic location, and the effects of large wood on sediment and channel form in New Zealand streams, we plan to investigate the role of large wood in retaining food resources and creating microhabitat, and its potential influence on water quality. The knowledge gained from this research will contribute to the management of our stream and river ecosystems.

Teachers: this article can be used for Biology L8 A.O. 8.1b. See other curriculum connections at www.niwa.co.nz/pubs/wa/resources

Further reading

Collier, K.; Ballie, B.; Bowman, E.; Halliday, J.; Quinn, J.; Smith, B. (1997). Is wood in streams a dammed nuisance? *Water and Atmosphere 5(3)*: 17-21.

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