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LARGE WOODY DEBRIS ARE IMPORTANT HABITAT IN RIVERS

by P.M. Davies & A.W. Storey

LARGE woody debris (LWD) or snags, form an important habitat in rivers and streams. However, during the 1920's and 30's lowland rivers on the Swan Coastal Plain (and across much of Australia) were extensively de-snagged on the assumptions that snags were a major cause of flooding, and contributed to erosion by directing flows against banks. However, recent research has shown that a river channel needs to be substantially blocked by LWD before there is a significant effect on the extent of flooding.

LWD affects water flow, and depending on orientation, modifies channel structure; providing different habitats such as pools, scour holes, slow flow backwaters and sand bars, which in turn maintains biodiversity. The main types of habitat formed by LWD depend on orientation and the river's power (see table1).

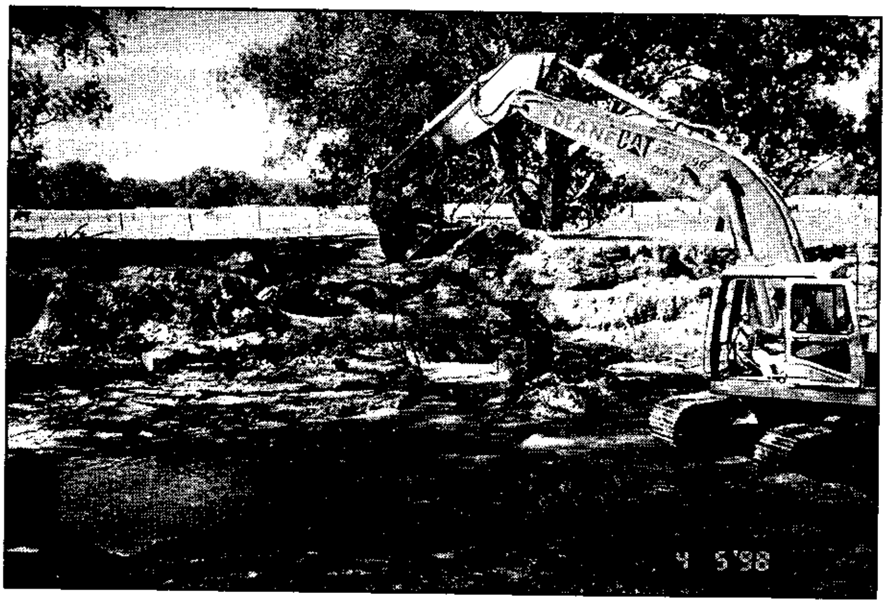
Scour pools formed by snags spanning the channel provide refuges for aquatic species during summer, and may contain the entire fauna of a river reach from which previously dry reaches are recolonised during increased flows in winter.

Branches extending into the water column and above the water surface will provide habitat at different water levels and single large trees that fall into a river can often provide a range of habitats.

In Eastern Australia, the trout cod (*Maccullochella macquariensis*) utilise snags that are located in high-current zones towards the middle of the channel and downstream of a bend, whilst the Murray cod (*Maccullochella peeli*), resides around the base of snags in slower-flowing currents closer to river bends.

Submerged wood with a complex surface structure of grooves, splits and hollows house a range of invertebrates, microbes (bacteria, fungi etc) and algae resulting in a 'biofilm'. Some aquatic fauna feed directly on the wood (e.g. chironomid midge larvae of the genus *Harrisius*), while others graze this biofilm (e.g. the mayfly nymph *Baetis soror*). A third suite of invertebrates use LWD as a platform from which they can filter their food (fine particulates) out of the passing water (e.g. the caddisfly larva *Cheumatopsyche modica*, and the blackfly larvae *Austrosimulium* sp. and *Simulium ornatipes*).

Birds, reptiles and mammals also use woody debris for resting, foraging and lookout sites. Birds commonly use the exposed branches of snags as perch sites, while turtles often climb out of the water onto snags to bask in the sun. Mammals and reptiles may use snags spanning the channel as crossing points. Many aquatic invertebrates have a terrestrial adult stage and require snags extending above the water surface to provide sites for emergence to the adult stages (e.g. various dragonfly species; *Hemicordulia tau, Orthetrum caledonicum, Diplacodes haematodes*).



During installation : A trench was excavated and the logs buried to half their diameter. The root balls were buried into the bank. Photo courtesy of Peter Davies.

Table 1: Habitat development as determined by snag orientation

ORIENTATION TO FLOW		HABITAT FORMED	
		upstream	downstream
Parallel		Scour pool	Bar/island
Angled		Combination pool/bar	Combination pool/bar
Perpendicular	- on bed	Depositional zone	Scour pool
	- above bed	Scour pool	Scour pool

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LWD is functionally important as sites of carbon and nutrient processing. In sandy, turbid rivers where woody substrate may be the only hard substrate available for colonisation, or in rivers that have been isolated from their floodplain by river regulation and clearing, most of the food for aquatic fauna is found on snags. The biofilm readily transforms available nitrogen and phosphorus by converting them to less-available compounds. This has the potential to reduce nutrient supply to downstream areas (e.g. nutrient flow to the enriched Peel-Harvey Estuary could be reduced by the reintroduction of snags to lowland rivers feeding the estuary).

In upland forested streams, LWD serves a slightly different role in that it helps retain large amounts of smaller woody material (sticks, leaves, bark etc) in the channel, resulting in the formation of debris dams (large accumulations of woody debris that often span the entire channel). This material is the main energy source of the system, forming a food supply for 'shredding' organisms, such as stonefly larvae of the family Gripopterygidae and the freshwater amphipod *Perthia branchialis*. LWD helps keep this material in the stream where it can be utilised, rather than it being flushed out of the system. This retained material is either shredded by animals or decomposes into smaller pieces and is subsequently transported downstream to provide a food source for filter feeders. In addition, flows over logs and debris dams often are turbulent and therefore help oxygenate the water.

Strategies for restoration and management of LWD

The ecological benefits of LWD are numerous. However, a river channel needs to be substantially blocked by LWD before there is a significant impact on flood conveyance. Only LWD which covers more than 10% of the channel cross-section or is oriented at right angles across the direction of water flow may cause substantial increases in local water levels. It is necessary to retain some pools, however in other areas existing LWD can be rotated downstream to an angle of 20° to 40° to the stream bank or relocated to slower flowing parts of the channel. Branches near the water surface, that tend to trap smaller pieces of debris and so form large accumulations may be lopped off.

Loads

- Aim to restore sufficient snag material to return the river to its natural load. This can be determined by measuring the amounts of wood present in more undisturbed reaches of similar river types (e.g. for lowland rivers on the Swan Coastal Plain look at uncleared sections of the Serpentine River). As a general rule, the volume of wood should be around 0.01 m^3 for every m^2 of channel surface.
- The actual amount of wood to return to the river also depends on the condition of the adjacent riparian land. Degraded riparian land with reduced natural inputs of woody debris to the stream may require a larger amount of wood to be restored compared with a stream with a more intact riparian land which will provide natural inputs. A cleared riparian zone that has been replanted may take over 100 years before regenerating its own supply of LWD.

Stability

- When a large tree falls into a river, the base of the trunk usually remains on the bank, sometimes partially buried. This prevents the snag from being swept downstream. Single large trees/logs re-introduced to a river may be anchored in the same way.
- Alternatively, a number of smaller pieces can be chained together and then anchored, either in the stream bank or by burying into the streambed.
- Reintroduced LWD may actually be used to increase bank stability. Anchored LWD may be placed on the outside of eroding river banks to improve stability.

Any LWD management programs, involving snag re-alignments, re-introductions, modifications or removals must be well planned and include an evaluation of possible effects, including ecological and hydrological implications.

Currently at Fairbridge, on the South Dandalup River, Peter Davies, in association with the Water & Rivers Commission, and with funding from the Land & Water Resources Research and Development Corporation, is running a LWD re-introduction program, incorporating much of the above. Over recent years much of the riparian land in the area has been fenced and revegetated, however, it will be a long time before it supplies LWD to the river. Therefore, snags are being re-introduced to assist the river to function more as an ecological entity. It is anticipated that when the riparian vegetation grows, it will be the ultimate supplier of LWD to the channel.

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