

# *Snags*

*a valuable  
but scarce  
resource*

Trees and branches that fall into and lodge in our rivers (snags) are an essential part of the river's ecology. They provide a place for a wide range of plants and animals to live and as water flows over and around snags, they help shape the river.

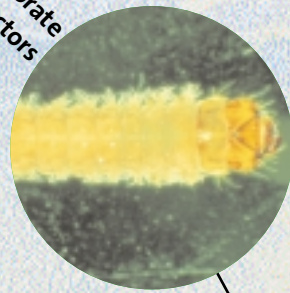
Across Australia, a huge amount of snags and other riverbank plants have been removed from streams in an attempt to improve river navigation and control flooding and erosion. In fact, this may have caused more problems for rivers and streams than it solved.

This brochure explains why snags are an essential part of river health and why they should be left intact wherever possible. With this information, river and catchment management committees, resource managers and community groups will be able to confidently argue for the conservation and restoration of snags in our rivers.

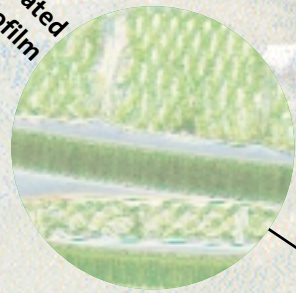
Big fish



Invertebrate grazers/collectors



Algal dominated biofilm



Birds

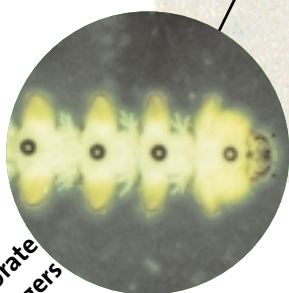


E

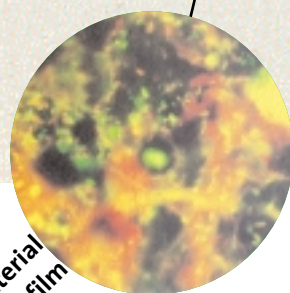
B

C

Invertebrate detritivores/gougers



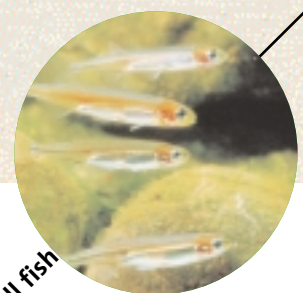
Fungal & bacterial dominated biofilm



Invertebrate predators



Small fish



# A diversity of habitats

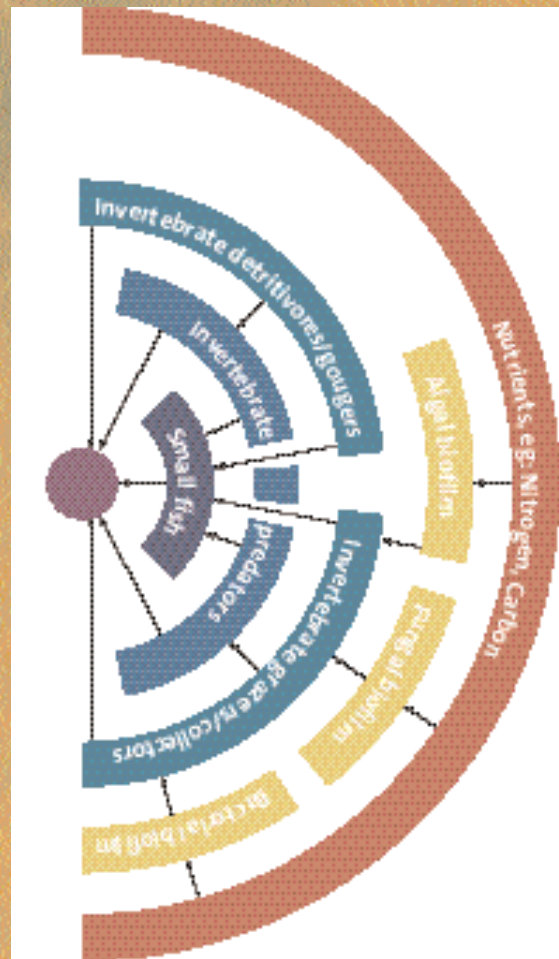
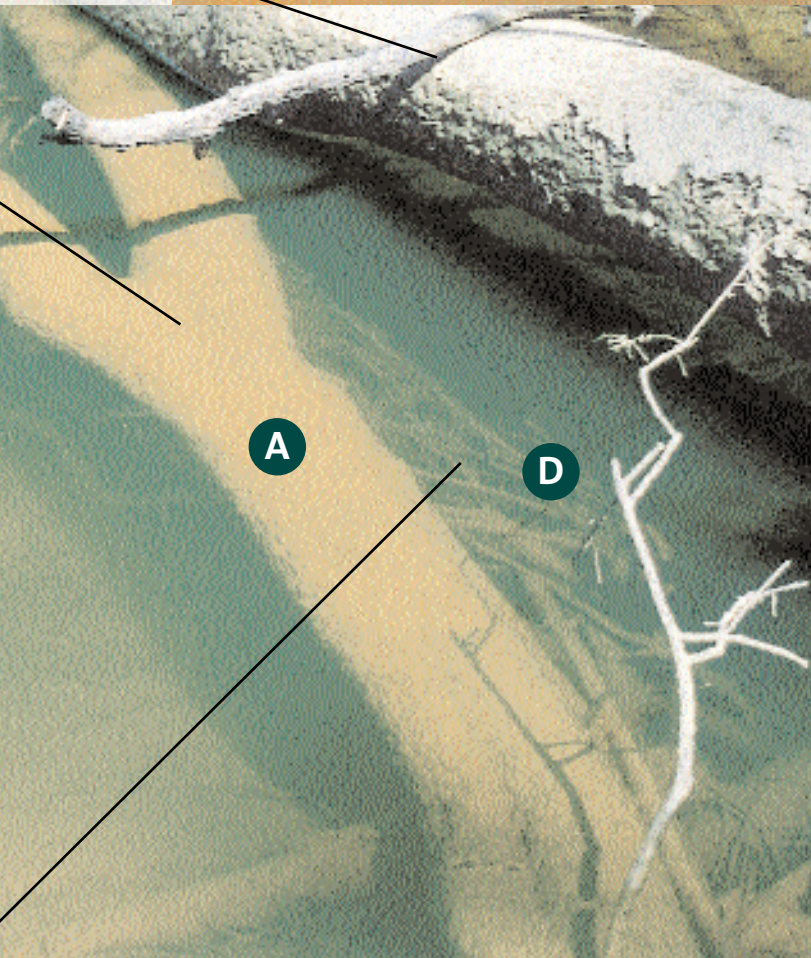


figure 1: the foodweb of a snag

- A Hard surface for biofilm attachment
- B Complex habitat for invertebrates
- C Accumulated detritus
- D Complex habitat for fish
- E Scour pool

Streams are not naturally tidy. Charles Sturt's 1838 River Murray expedition described a river system full of snags "I sent a man to the Northward, who found the country intersected by deep creeks, full of decaying timber...". Since de-snagging (removing snags) began, huge numbers of snags have been removed from our rivers. Between 1911 and the late 1960s, for instance, a snag boat removed about three million snags from the River Murray. Most of this de-snagging aimed to improve river navigation, because being holed by a snag was the major danger for early riverboats.

Unfortunately for the river's ecology, de-snagging was highly successful. By 1973 there were only about 1,200 snags remaining in the River Murray in the 330 km's between Lock 6 and Wentworth. Removal has continued until recent times.

Most attempts at improving rivers through de-snagging have actually damaged the rivers' ecology. For example, river-works in the Broken River in Victoria between 1960 and 1975 focussed on de-snagging to minimise flooding. It now seems clear that this de-snagging has led to erosion of the stream bed, and a lack of habitat for large native fish and other biota (living plants, animals and organisms).

Fortunately de-snagging is not generally practised now, but the legacy continues.

## Why are snags so good?



Snags have been described as the lowland river\* equivalent of marine reefs. It is the place where the greatest numbers and diversity of lowland river biota are found.

Snags provide habitat for many plants and animals, from microscopic bacteria, fungi and algae, through to large native fish and platypus. Snags that stick out of the water provide roosting places for birds and other animals such as turtles.

\* *Lowland Rivers: rivers that flow through lower, flatter parts of Australia. Usually slow-moving and meandering; more than 97% of Australian rivers.*

Above: Toad-bug (*Nerthra* sp)  
Photo: J Hawking

Some parts of snags will be exposed to fast flowing water and others to still water. Water flowing over or around snags may form eddies or still water areas that provide refuge for animals from faster currents. Some snags rest in open, sunlit conditions, while others may be shaded or in darkness. Some places will accumulate organic material and silt, while passing water will flush others. The position of snags in a river may also vary, from those lodged in the bottom sediments and deep pools, to those that protrude into the air and onto land.

The rough surfaces, hollow logs, differences in light and shade, flow regime\* and depth, all enrich the variety of habitats in a river. This diversity of habitat provides homes for many different animals, algae, fungi and bacteria. Snags also trap leaves and other small pieces of organic material, creating a maze of nooks and crannies and providing a variety of food sources.

Snags become more important as the condition of the banks and streamside (riparian) vegetation declines.

In degraded rivers, snags provide some of the little remaining structured habitat.

## River factories - production, decomposition and nutrient transformation

Leaves and twigs washed into the river get trapped behind snags, where they form rich reservoirs of food. These deposits of food become hotspots of microbial and animal activity. Fungi and bacteria living on the surfaces of snags contribute to its breakdown and in turn become food for other microscopic life forms.

Bacteria, algae and fungi form a slimy coating over the snag, called a biofilm. The biofilm provides a rich food source for many invertebrates while the snag itself is a source of food for wood boring beetles and some fungi and bacteria. As wood is broken down, carbon and other nutrients in the wood are eaten by microbes, algae and animals, which in turn provide food for other organisms in the foodweb (Figure 1).

The biofilm also traps nutrients needed for growth from water flowing past. It can rapidly remove nitrogen and phosphorus from the passing water. This reduces the supply



# *A place to call home*



of nutrients for nuisance algal and plant growth downstream. The removal of snags, and the loss of biofilm along with them, may severely reduce the capacity of a river to transform and retain nutrients. Removing snags may increase the river's susceptibility to high levels of nutrients and the resultant growth of nuisance algae and plants, such as blue-green algae.

*\*Flow regime: the pattern of rising and falling flows over time; can be measured over days, weeks, months or years.*

## Macroinvertebrates

Larger invertebrates (animals without backbones) such as beetles, bugs, shrimps, yabbies, molluscs and worms are an important part of the food web in rivers because they provide food for many other animals, including birds, fish, frogs and platypus. They are also used widely to measure river health.

Snags provide a home and food for many different types of invertebrates; the invertebrate communities of snags are often unique to that habitat. Studies the world over have shown a greater number and diversity of invertebrates in sections of river with snags, than in sections of river without snags. In lowland rivers, there is generally a greater number and diversity of invertebrates per unit area of snag than any other surface.

In Australia's lowland rivers, snags provide one of the few hard surfaces. Invertebrates like caddisfly and mayfly larvae like to attach to these hard surfaces so that they can feed from flowing water. Other invertebrates feed on the biofilm coating the snag or on the wood itself.

Larger invertebrates like crayfish and shrimp hide in amongst snags while snags that protrude from the water provide places for invertebrates like dragonflies to transform from aquatic larvae into terrestrial adults.

### **Opposite-**

*River Murray Crayfish*

*Photo: D. Eastburn*

*Pul Pul Billabong, Kakadu National Park*

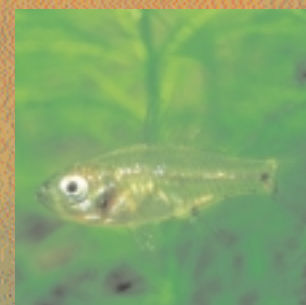
*Photo: A. Georges*

### **This page-**

*Western Chanda Perch*

*(Ambassis castelnaui)*

*Photo: G. Schmid*



## Fish

Snags are the most important habitat for native fish in our lowland rivers. Indeed, recreational fishers have been the greatest advocates for snags—they have long understood their value.

Snags provide shade, protection and resting places for fish. This can be particularly important in fast currents and during periods of high flow. As water flows under and around snags it erodes deep pools which are important refuges for fish such as Golden Perch. Snags also provide calm spaces, away from the fast currents, for fish to rest. Snags may act as staging posts for fish as they migrate over long distances. Murray Cod can migrate over one hundred kilometres to spawn, and then return to the same snag. Snags may provide reference points to help fish orientate themselves in their surroundings. River Blackfish lay small numbers of eggs in the safety of hollow logs, while other fish lay sticky eggs that attach to the hard surfaces of snags.

Different species of fish use different parts of snags. It has been suggested that Murray Cod and Trout Cod prefer to use snags in the deeper parts of the stream, while the Trout Cod chooses the middle of the channel and the Murray Cod prefers areas closer to the bank. To accommodate the needs of a full range of native fish, at least some snags must extend from the banks into the main part of the stream, and from the bottom of the river to above the water line.

Studies undertaken by the Cooperative Research Centre for Freshwater Ecology and others have shown that streams with snags are likely to have higher numbers of fish and invertebrates than those without. Attempts to re-introduce native fish to our rivers will not be as successful as we would hope unless we also provide suitable fish habitat. In many streams, successful re-introduction of native fish will also probably mean re-instating snags.

Snags play an important role in creating and maintaining the shape of streams (their geomorphology). By creating a variety of habitats in sand and clay bed streams, snags produce a range of faster and slower flows and deep scour pools in streams.

Streams deposit and erode sediment as they move across the landscape. The formation of pools in the streambed and undercutting of banks is essential for providing habitat diversity, and natural streams are often lined with undercut banks.

Depending on local conditions, snags may increase or decrease bank erosion. Snags can increase erosion by deflecting flow onto stream banks. This effect is usually minor if the banks are stabilised by healthy vegetation. Snags can also prevent bank erosion by shielding the banks from fast flows (armouring), by slowing down local water flows and by deflecting flows away from banks. Whether snags increase or decrease erosion will depend on local

## *Snags shape the river*

conditions such as the size, location and orientation of the snags, the depth and speed of flow, the character of the bed and bank, and the amount and type of riparian vegetation.

Since European settlement, a massive amount of fallen timber and bank vegetation has been removed from streams in often-misguided attempts to reduce flooding and erosion. In contrast, recent research shows that snags do not usually effect flows. Unless they comprise more than 10% of the projected cross section of a stream, their effect on flow is not significant. Generally, snags have their greatest impact on flow in smaller streams. As a stream gets wider or deeper, the relative impact of snags on flows, flooding and erosion reduces.

Removing snags and vegetation is likely to increase, rather than decrease, erosion and downstream flooding. Studies of paired-catchments, one in a natural state and one cleared of vegetation and snags, have shown that removing snags and riparian vegetation results in faster and stronger

stream flows. This causes the deepening and widening of stream channels as the stream bed erodes. Also, the amount of sediment picked up and moved by the river increases. While removing snags may cause water to leave one spot more quickly, it often causes increased flooding downstream. In turn, this can lead to a knock-on effect, where more snags are removed downstream to reduce the newly-created flooding caused by upstream snag removal.



Ultimately, extended lengths of rivers have been cleared in this manner, aggravating flooding downstream.

Snags play an essential role in stabilising waterways and many river managers are actively protecting and reinstating snags.

## Protect remaining snags

The most important action is to protect the few remaining snags in the river systems. Removing snags must be seen as an absolute last resort—for example, if they are immediately upstream and threatening an important asset such as a bridge. Even then, the snag can be removed and replaced downstream. The best policy is to leave snags where

*The Australian  
Pig-Nosed Turtle*  
Photo: A. Georges



Snag realignment, where large logs that span a river are moved so that they lie at an angle of 20° to 40° to the stream bank, has been advocated as a method for improving the flow capacity of a river channel. While sometimes there may be a minor improvement in channel capacity, the environmental value of the snag may be lost. For example, realignment will reduce snag habitats in the deeper, fast flowing water in the middle of the stream (the preferred habitat for the endangered Trout Cod). Undoubtedly though, snag realignment is better than snag removal.

# Managing snags

## Protect the source for future snags

Healthy, mature streamside (riparian) and floodplain vegetation is the source of most snags. To ensure a natural supply of snags into the future we have to protect and restore riparian and floodplain vegetation.

## Consider restoring snags through river restoration projects

Restoring snags is a difficult and expensive task. Just how to do this successfully is being investigated by the CRC for Freshwater Ecology in the Granite Creeks area of Victoria. Australia-wide there are not enough natural snags available to fully restore all of the lowland rivers to their original state. We will have to be smart about how and where snags are replaced. For example, how close together do snags have to be? In which part of the river do they provide the most benefit? The CRC for Freshwater Ecology is undertaking research to answer these and other questions about snags.

they are. In most cases they will not cause flooding and besides, snag removal is likely to result in increased erosion and potentially greater flooding problems downstream.

**Protect snags • Protect the source for future snags • Restore snags**



# *New facts*

## *about snags*

Understanding the importance of snags to the ecology of rivers is an important aspect of research undertaken by the Cooperative Research Centre for Freshwater Ecology. Research projects being done by the CRC for Freshwater Ecology include:

### **Golden Perch and Carp**

Early results indicate that native Golden Perch strongly prefer snags in deep-water. Interestingly, introduced carp are not nearly so associated with deep-water habitats or snags. For this project, a CRC for Freshwater Ecology PhD student is precisely mapping snags in the river and attaching radio transmitters to the fish to see how and where they move around.

### **Restoring fish populations**

How many snags need to be returned to the river to effectively restore fish populations? To answer this question, researchers at the Department of Natural Resources and Environment Victoria (DNRE) are comparing the number of fish with the amount of snags in the River Murray above and below Lake Mulwala. With this information, a pilot resnagging study will be undertaken.

### **Murray cod, Trout cod and snags**

Researchers at DNRE have found that Murray Cod migrate long distances after flooding events, using snags as shelter rather than moving through the deepest parts of the river where the current is faster. Young Murray Cod remain in the river channel during large floods (rather than move to billabongs or onto the floodplain) where they use snags as shelter. Trout Cod also prefer snag habitat in the river.

### **New ways to bag snags**

Snags are very difficult to sample. They are often in deep water, slippery, hard to access, and provide lots of places for invertebrates to hide. To overcome these difficulties, researchers at the Murray Darling Freshwater Research Centre developed a new way of sampling invertebrates on natural snags. This involves wrapping a specially designed 'snag bag' around the snag and using a brush to dislodge invertebrates from the snag. The current flowing past the snag washes the invertebrates into the sampling bag. While the technique is effective, you still have to swim out to your snag!

### **Snags contribute to biodiversity**

Preliminary results from Monash University research have shown that snags make an important contribution to the biodiversity (number of different types of invertebrates) in the Yarra River, Victoria.

### **A vital link in the food chain**

Researchers at Monash University have shown that the biofilm growing on snags contributes significantly to the amount of beneficial algal growth in the Ovens River. Biofilm growth is high in summer and autumn when warm temperatures and low flows provide ideal conditions for growth. Results indicate that the biofilm on snag surfaces contributes to the carbon supply and hence food supply in the river.

A LWRRDC booklet on managing snags is available (*RipRap* edition 16/2000). Visit the LWRRDC web site: <http://www.lwrrdc.gov.au>



Snags are an important part of freshwater ecosystems. By providing a great variety of habitats, snags support a diversity of plant and animal life. Unfortunately, large-scale removal of snags from waterways has damaged overall river health. To improve the health of our rivers, snags should be protected or reinstated wherever possible.

The Cooperative Research Centre for Freshwater Ecology is a collaborative venture between:

- ACTEW Corporation
- CSIRO Land and Water
- Department of Land and Water Conservation, NSW
- Department of Natural Resources, Queensland
- Department of Natural Resources and Environment, Victoria
- Environment ACT
- Environment Protection Authority, NSW
- Environment Protection Authority, Victoria
- Goulburn-Murray Rural Water Authority
- Griffith University
- La Trobe University
- Lower Murray Water
- Melbourne Water
- Monash University
- Murray-Darling Basin Commission
- Murray-Darling Freshwater Research Centre
- Sunraysia Rural Water Authority
- Sydney Catchment Authority
- University of Canberra

**For further information**

Visit the CRC for Freshwater Ecology web site:  
<http://freshwater.canberra.edu.au>

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