



# Western Wildlife



NEWSLETTER OF THE LAND FOR WILDLIFE SCHEME

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## FARMTREE CORRIDORS AND DAMS BRINGING BIRDS BACK TO THE BARNYARD

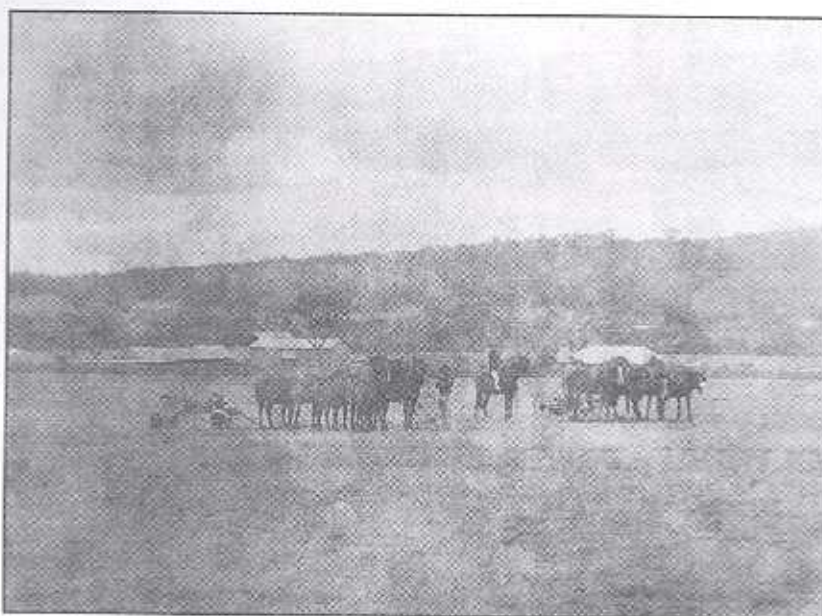
by Jim Masters

A brief  
history of  
'Glen Avon'

I have always loved nature, and since I have lived in this area, have always been interested in the intricate processes that occur along the Avon River. I also enjoy finding out about the local history of the area, as it gives one a much better picture of just where we are at in the scheme of things. Birds are of a particular attraction to me, and I have spent many years recording their habits and distribution throughout the central wheatbelt.

The homestead where I have lived for much of my life is situated about half a kilometre from the edge of the Avon River, and part of it was built in 1843 on one of the first land grants made here in 1832.

About the home by 1890 some 500 acres of natural York gum and jam woodland had been cleared for grazing and cropping, as were many of the flooded gums bordering the banks of the main creek feeding the Avon River. The banks of the Avon,



*Glen Avon homestead area, circa 1890's. View to northeast. Avon River flows northwest beyond buildings. Charles Henry Wilkerson, then-owner, is mounted on the centre horse, with two teams pulling the newest innovations of the era, a multiple disk and moulboard plough.*

*Photo courtesy of Jim Masters.*

however, would appear to have remained largely unaltered (apart from grazing), because of the constant threat of floods, by then well known. As a result this riverine vegetation still provides an important corridor for wildlife habitation and movement since the initial clearing.

As with many farms in the central wheatbelt, constant grazing pressures have meant that very little regrowth has occurred, and gradually the older vegetation has died off to leave many bare hillsides. Those original specimens that still remain consist of scattered ancient York gums with no understorey, although they still provide a corridor for bird movement, together with old

flooded gums along some creeks.

My family moved to Glen Avon in 1917, where we still continue to farm sheep and crops. In difficult times during the 1930's I finished my schooling at Scotch College in Perth, and moved back to the farm to help my father. Growing up on the farm meant that I was to spend a lot of time outdoors learning about the environment, and in 1930 I decided to start recording the changes in the wildlife of the area, particularly that of bird populations along the Avon and around the cleared homestead. My parents had planted a variety of sugar gums and other plants around the homestead



## EDITORIAL

*Hi everyone!*

**W**ATER, water everywhere! Yes, it is that time of year when the days are shorter and the weather is wetter. Well, at least for some of us, anyway - Penny is currently enjoying a well-earned break from work, and is somewhere in the middle of Europe. We welcome to the office David Lamont, who has taken on Penny's duties while she is away. Many of you would know David as the Executive Officer of the Roadside Conservation Committee.

In this issue the focus will be on wetlands and their importance as waterbird habitats. We will also look at other water and winter related topics. Included are the experiences of two *Land for Wildlife* members who have created wetlands on their properties, and the changes they have seen in the wildlife visiting them.

I would like to take this opportunity to bring to everyone's attention our new *Land for Wildlife/Off Reserve* Conservation Officers. Please

extend a big welcome to four new ORCOs - Heather Adamson, Jenny Dewing, Cherie Kemp and Robyn Stephens. These wonderful and keen people will be working with both *Land for Wildlife* and Bushcare. Speaking of Bushcare, Western Australia also has two new Bushcare Facilitators - introducing Gary McMahon (Bunbury) and Ann-Marie O'Callaghan (Geraldton). Further appointments will be made this year. Contact details for the ORCOs are given in the table below.

On a different note, has anyone noticed how the onset of cooler and wetter weather seems to attract all of those wonderful creatures such as huntsman spiders, cockroaches and the like, into our sheds and homes? I have already started noticing some freeloaders, and am beginning to get the impression that these creatures are solar powered ...

Best wishes until next time,

*Emma Bramwell.*



Contact details for

*Land for Wildlife/Off Reserve* Conservation Officers

| LFW/ORCA        | Location   | Phone number (work) |
|-----------------|------------|---------------------|
| Heather Adamson | Merredin   | (08) 9041 2488      |
| Avril Baxter    | Narrogin   | (08) 9881 1444      |
| Jenny Dewing    | Bridgetown | (08) 9761 2318      |
| Bob Huston      | Mundaring  | (08) 9295 1955      |
| Cherie Kemp     | Busselton  | (08) 9752 1677      |
| Sylvia Leighton | Albany     | (08) 9842 4500      |
| Robyn Stephens  | Morawa     | (08) 9971 1438      |

*continued from page 1*

some ten years before I started recording changes, so by now there was quite a well established garden.

Between 1930 and 1945 I recorded some 84 different species of birds, about half of these being uncommon and occasional visitors while most of the others are resident species. Not a bad score considering I can remember only 26 species close to the homestead before 1930. However, during this period there was a massive rabbit plague, which did affect bird populations, not all adversely since raptors increased, until the virus myxomatosis virtually wiped the rabbits out by 1956. Even in areas of York gum and jam woodland totally protected from grazing by domestic animals, for at least thirty years few tree seedlings, particularly of acacias and sheoaks, were able to survive due to the thousands of rabbits. With much of the understorey shrubs also dying out, the population here of small 'bush' birds decreased enormously. In the period 1945 to 1960 however, 90 species (23 breeding here) were recorded about the homestead now enclosed by more tree planting.

### Creation of the dams

During 1960 we were able to build a large farm dam, which with some fringing vegetation has become a regular visiting point for waterbirds. In 1978 a much shallower and smaller dam was built alongside the first, designed with the purpose of providing a safe nesting site for waterfowl. Initially used for irrigation, they are built close by to the river 'corridor'.

*continued on page 3*

### Errata

Please note that in the last issue of 'Western Wildlife' (volume 2, number 2) the captions for the two photos in Sheila Hamilton-Brown's research article (page 12) have been mixed up. Our apologies for any confusion this may have caused our readers and the author!



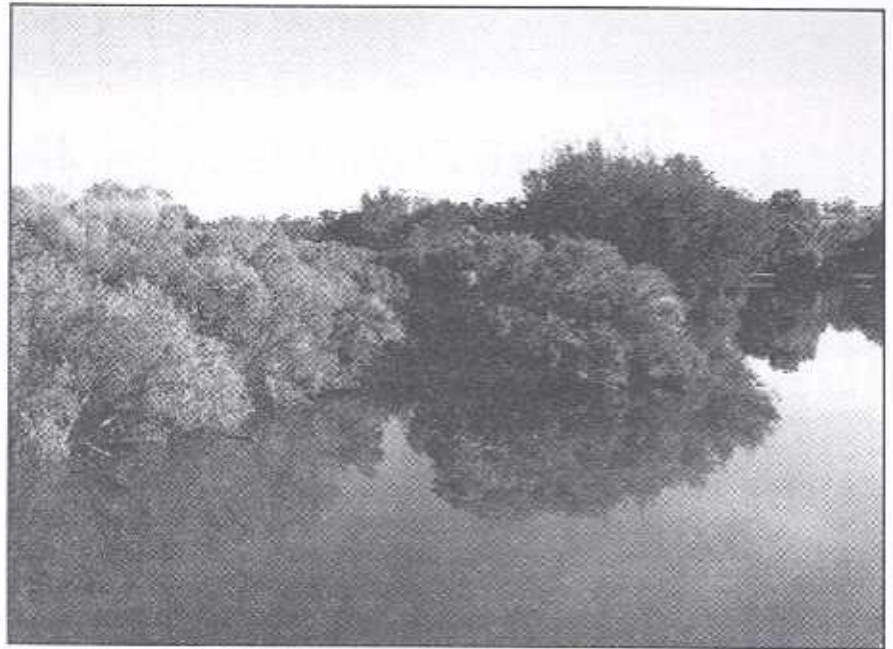
*continued from page 2*

These dams are known as semi-turkey nest dams. Banks are pushed up around an old swamp bed, and in this way it is not necessary to lower the original bottom layer. As the bottom layer is already adapted to holding water, and is at a natural water outflow level, a bottom drainpipe is installed.

For the amount of earth moved to build them, the amount of water held is up to twelve times greater than an excavated dam high up the slopes of a farm hill. Seepage occurs to some extent through the dam walls and bottom. These dams are filled by weir diversion from the main farm creek, thus avoiding flood and silt damage.

We used three major tree species found along the Avon in our area (flooded gum, freshwater paperbark and salt sheoak) to vegetate the dam, attempting to mimic nature in our approach to growing them. Seeding branches were cut from mature trees bordering the river, and dragged by tractor into and about the new dam bed in autumn. Here seed then dried and matured before the winter rains. Following this, we allowed the area to be completely inundated with water (as would naturally happen at this site during winter months). As water level fell in spring seedlings started to emerge. Then next winter we controlled the water level by use of the control gates of intake weirs so the young plants could attain a height above that of the winter water depths, after which we allowed nature to take its course and inundate them to full dam level.

As is well known in the area, the clearing of the high laterite wandoo forests here over the 1960's has led to increased salinity in the creeks on Glen Avon, which has created a few problems with the dams. Surprisingly though, the increase in salinity levels does not appear to have affected the wildlife to any great extent, which suggests to me that brackish water is quite acceptable to our wetland wildlife and that many seem to be well adapted to it. In fact, I have noticed at least two species of shellfish that



*View of the shallow paperbark swamp. Such ephemeral conditions, as demonstrated by this wetland, are favoured by breeding waterbirds when much shrub cover is provided. Photo by Jim Masters*

have moved into our area, for it seems such 'estuarine' conditions favour them as well as some waterbirds.

Between 1978 and 1980 we decided to create an extensive corridor between the homestead and the dams, using hundreds of tree and shrub seedlings. A second corridor was planted between the homestead and a stand of old York gums about one kilometre from the river. This has linked the river and dams with the homestead revegetation and, further away from the river, with creekline vegetation and ridgeline woodlands, using appropriate fencing to control the stock from grazing during development.

Since 1960 up to date we have had 147 species come here and 51 nest, most only occasionally, though about 20 breed regularly.

## Maintaining bird populations

I am certain this success of bringing birds back to a formerly bare part of the farm has been due to the careful linkage via tree corridors of the Avon River frontage with a number of natural regrowth stands throughout the farm. The woodland

birds use the corridors to move across the farm, while the waterbirds use the dams as extra habitat, and protection from disturbance by boating activity in the river. Best of all it has brought back many 'bush' birds right to the home garden birdbath, where 43 have been noted using it. Quite a few of these, particularly the honeyeaters (11 species), have their more usual habitats existing many kilometers to the east or west of Glen Avon. Almost certainly they come here along now often quite sparse corridors about the Avon Valley.

## Conclusion

The history of this very old farm's wildlife makes it obvious however that much more regenerated woodland areas are needed to restore fauna populations to that which existed here sixty years ago. We still have a great diversity of the fauna but much of it in a precarious state. As this story of the birds here indicates, there are ways to bring quite a lot of it back, even to your home and barnyard.

*Jim Masters is a farmer/naturalist and nationally known authority on birds.*



# FAUNA

## THE AESTIVATING SALAMANDERFISH

**M**ANY species of fish have been reported to hibernate in response to cold, or aestivate (a form of hibernation to avoid desiccation) in response to heat and dryness; aestivation is particularly common for fish in ephemeral water bodies. The most widely reported aestivating fish are the African and South American (but not the Australian) lungfish. These large fish form a cocoon in the mud and use a modified swim bladder (lung) for aerial respiration.

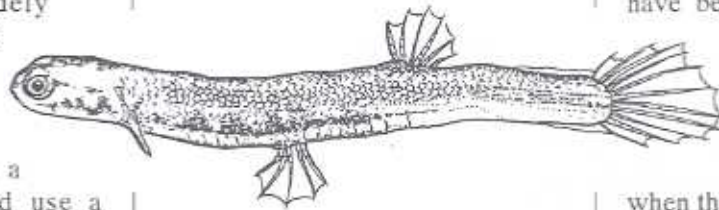
There are eight endemic species of fish in the rivers, creeks, and waterways of the southwest of Western Australia as well as a number of exotic species. The endemic fish fauna of the southwest is unique in many ways, with at least two of these species aestivating when the ponds and creeks dry up in summer.

The two small fish known to aestivate are the salamanderfish (*Lepidogalaxias salamandroides*) and the black-striped minnow (*Galaxiella nigrostriata*). Both fish are found in shallow, ephemeral, peaty swamps that are characterised by low pH and high dissolved organic content. When the small peaty swamps and creeks dry up, the two fish "disappear"; they return when the depressions fill with water during the subsequent winter months. The stimulus that triggers these fish to burrow and aestivate, and their associated physiological responses, is not well understood.

The salamanderfish has a wedge-shaped skull and very flexible vertebral column to facilitate burrowing into the peaty sands of the area. In addition, males internally fertilise the eggs of females, which is perhaps an adaptation to the acidic environment. Most fish live for two years but

### WHERE DO ALL THE FISH GO?

by Graham Thompson  
and Philip Withers



*L. salamandroides*

some can survive for up to four years. Females spawn in August-September, with juveniles increasing in size until they mature with a snout to vent length of 67mm. They feed on mainly aquatic crustaceans. The lack of permanent water means that in most habitats the salamanderfish has no large fish predators. However, the abundant freshwater crayfish (*Cherax preissii*) will certainly eat them, as will wading birds.

Less is known about the black-striped minnow. These fish have not been shown to aestivate in captivity (as has the salamanderfish), nor have they been dug up from the mud. They do, however, appear shortly after the first rains or when pools have been artificially filled with water. It has been suggested that this fish might use the extensive subterranean burrows of the freshwater crayfish

when the surface water disappears, rather than aestivating in dry soil. They feed primarily on flying ants and aquatic crustaceans. Spawning occurs between June and September.

Aestivating fish face a number of major physiological problems, including water balance, excretion or accumulation of metabolic wastes, and economy of energy. The high content of decaying organic materials in the ephemeral swamps of the southwest of Western Australia is likely to reduce the availability of oxygen in some of these waterways.

*continued on page 5*



A shallow, ephemeral pond typical of the habitat of *L. salamandroides*. The water is generally black or darkly stained so there is no possibility of seeing the fish in the water.



## FAUNA

continued from page 4

Our study investigated the metabolism of these fish in water and in air, and under conditions of decreased oxygen availability as might be experienced in their natural environment. We found that when lying still in water, the salamanderfish has a metabolic rate of approximately double that in air. As available oxygen is reduced, metabolic rate decreases in both water and in air. It is not known for how long the salamanderfish can sustain these low levels of oxygen consumption as carbon dioxide production remains high. These high carbon dioxide production rates compared with the oxygen consumption rates suggests that at low oxygen concentrations, the salamanderfish is either depending on oxygen stored in the swimbladder, or on anaerobic energy sources which can not be sustained indefinitely because of the progressive build up of lactic acid, which inhibits nerve and muscle function and promotes carbon dioxide excretion.

The lower metabolic rate of the salamanderfish in air may be due to a physiological inability to supply oxygen or, it may reflect a lower demand for oxygen. In moist air, salamanderfish will generally remain motionless on the substrate. The transfer of gases is presumably across the skin, therefore there is no requirement to pump water or air across the gill filaments, consequentially saving in the energy requirement.

Many animals that aestivate (e.g., desert frogs and snails) can reduce their metabolic rate to about a fifth of their basal level as an energy conservation strategy.

During extended periods of inactivity confined to a small burrow, it would be advantageous for the salamanderfish to conserve its energy reserves by reducing its metabolic rate. Earlier research suggests that the salamanderfish uses its lipid (fat) reserves as the primary energy source during

extended period of aestivation. Lipids are also the energy resource used by females for egg production within a couple on months of emerging from aestivation. The long term survival of the species would be enhanced by increased egg production, and therefore minimising the metabolic demand and stored lipids during aestivation could increase fecundity.

Where to from here? Nothing is known of the trigger that causes salamanderfish to aestivate. Large fish often disappear first, long before the ponds are completely dry suggesting that the stimuli for aestivation might not be the drying up of the ponds. Efforts to induce the fish to aestivate in a laboratory have been unsuccessful. The exact location of aestivating salamanderfish is also unknown, as our excavations of the dried mud in the areas of the last surface water failed to locate any fish. The next

stage of our research is therefore to locate aestivating salamanderfish. This will give us the opportunity to explore further the physiological adaptations of these fish that have evolved to enable survival for months out of water, perhaps in a moist burrow, in a thick layer of mucus, with a lowered metabolic rate. Laboratory studies of animals can not always replicate what is actually occurring in the field. It is therefore important to confirm the results from laboratory studies with field data.

*Dr Graham Thompson is from the Centre of Ecosystem Management at Edith Cowan University and Assoc. Prof. Philip Withers is from the Zoology Department of University of Western Australia. This study was undertaken with financial assistance of a small ARC grant administered through Edith Cowan University.*

## FROM THE INTERNET

### Eagle takes horse



As many would know, rabbit calicivirus disease has spread patchily through southern Australia, decimating some rabbit populations, but leaving others unaffected. Where rabbit numbers have plunged, Wedge-tailed Eagles, *Aquila audax*, which feed mainly on rabbits must find other food sources, move elsewhere, or die. Other foods are limited, and I have received several reports of eagles taking lambs or goat kids, in areas where rabbit numbers are reported to have declined,

Miniature horses are growing in popularity, but are rather expensive. A miniature horse breeder in central Victoria was horrified to see a 2 kg foal, which she had already sold for more than \$2,000, seized and carried away by a Wedge-tailed Eagle. The foal was very much alive and healthy when taken. Its half-eaten carcass was found elsewhere on the property later in the day. As far as I am aware, this is the first record of a horse being taken by a Wedge-tailed Eagle!

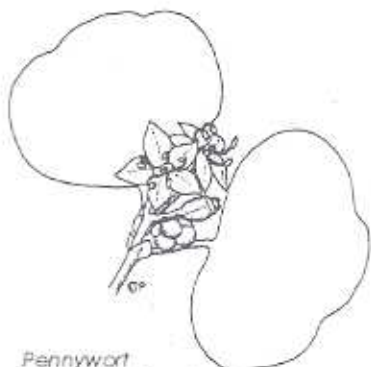
from: Ian Temby to BIRDING-AUS: 15 June 1998



## FLORA

### RARE PLANTS IN WET AREAS

by Mike O'Donoghue



Pennywort  
Drawing by Sue Patrick

**W**ETLAND areas support a wide variety of flora and fauna species, many of which are only found in these habitats. Because these environments are so specialised, the survival of many species depends upon the survival of the ecosystem in which they occur. Unfortunately, many of the wetlands in the agricultural areas of the State have become saline as a result of land clearing, and no longer support the diverse range of species which once occurred in them. Others have become severely degraded and weedy, or are found as small remnants in otherwise completely cleared land.

Some wetlands within the south west land division however, still support a variety of rare and unique West Australian plants. These areas provide essential habitats for the conservation of some of the State's rare and threatened plant species. Species, which are considered likely to become extinct or rare in the wild, or are in need of special protection, are gazetted as rare flora under the *Wildlife Conservation Act 1950*.

Examples of some of the plants listed on CALM's Declared Rare and Priority Flora List are provided below:

The stalked water ribbons, *Aponogeton hexatelpalus*, is a perennial tuberous aquatic herb which occurs in temporary freshwater swamps between Perth and Busselton. This species has erect leaf stalks which support floating leaf blades to 20 cm long. The tiny flowers of this species appear during August to September.



Water ribbons  
Drawing by Sue Patrick

The aquatic pennywort, *Hydrocotyle lemnaeoides*, is a small annual herb found in shallow fresh water pools in clay soils. Like the stalked water ribbons, the aquatic pennywort persist only as

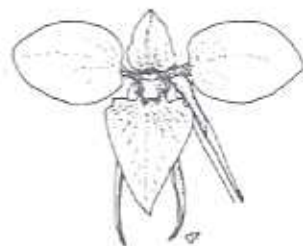
underground rootstocks until the depressions in which they occur fill with water following the onset of autumn/winter rains. The species flowers in September and October.

The floating bog-rush (*isn't this common name just the best!* - Ed.) *Schoenus natans*, is an annual aquatic which has submerged stems which are very slender and hair-like forming floating masses over 30 cm long. It occurs in small pools in seasonally wet flats or larger swamps near Gingin, south to Ludlow. This unusual species was presumed to be extinct until recently when it was rediscovered in an area of bushland near Pinjarra. Following its rediscovery CALM staff undertook specific surveys and located additional populations. This species is no longer considered to be rare, but still requires special attention as it relies on the maintenance of the temporary wetland area in which it occurs.

The granite myriophyllum, *Myriophyllum petraeum*, is an annual aquatic herb restricted to ephemeral rock pools. The species occurs on granite outcrops between Southern Cross and Cape Le Grand National Park where it grows in 10-30 cm of water. The species is vulnerable to local environmental disturbance including water

harvesting, pollution of rock pools, fertiliser runoff from aerial fertilisation, goats, and weeds.

Another, even rarer *Myriophyllum* is *M. lapidicola*. This plant was first collected in 1989 from a single rock pool near Mukinbudin. Goats were recorded in the vicinity of the population at the time of its discovery. This extremely rare aquatic herb has leaves which are confined to the upper parts of the stem. These leaves have pinkish-brown tonings and float on the surface of the water. It has very small red flowers which are located in the axils of the upper leaves. Only one other small population of this species has been located since its original discovery, despite considerable survey effort. This taxon is regarded as critically endangered.



Purdie's donkey orchid  
Drawing by Sue Patrick

Other rare plants are found only in winter-wet areas.

For example, the very rare and beautiful Purdie's donkey orchid, *Diuris purdiei*, occurs in low-lying, winter-wet depressions between Kenwick and the Harvey estuary. This very small orchid grows to 25 cm and produces flowers in September to October only following summer or early autumn burns. Unfortunately, much of this orchid's preferred habitat in the Perth metropolitan area has been lost through urban and industrial development.

The Swan hydatella, *Hydatella dioica*, is a minute tufted aquatic annual to 2 cm high with partially submerged red-coloured leaves and stems. This species was first collected in 1898 at Midland, but was then not seen until its rediscovery by Greg Keighery in 1982. This small plant grows in shallow water over winter-wet



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claypans at Ellen Brook and Kenwick. Much of its habitat in the Perth metropolitan area has also been destroyed. In addition, further clearing and changes in the hydrological balance, and the potential problem of water contamination, may affect the long-term survival of this species in the wild.



As a community we need to support and encourage the preservation of our remaining wetland areas if we are to ensure the survival of some of the State's rare and unique plant species. We need to protect remaining wetland areas if we are to ensure that a very important part of our natural heritage is preserved for present and future generations to enjoy.

(Since this article was written, the stalked water ribbons, aquatic pennywort, floating bog-rush and granite myriophyllum have been removed from the rare flora schedule, as they are no longer considered rare following the discovery of further populations - Ed.)

Mike O'Donoghue is the Administration Officer for Flora, at CALM in Como, and is contactable by phone on (08) 9334 0422. If any members of Land for Wildlife are fortunate enough to find rare flora in their wetlands, CALM would be very interested to know about it.

† = Rare plants, declared as rare flora under the Wildlife Conservation Act are protected on all lands. Such plants are considered likely to become extinct in the wild, or are considered rare and therefore in need of special protection to ensure their continued survival. Your local CALM office could advise you as to whether you may have rare plants on or near your property.

## BUSH DETECTIVE



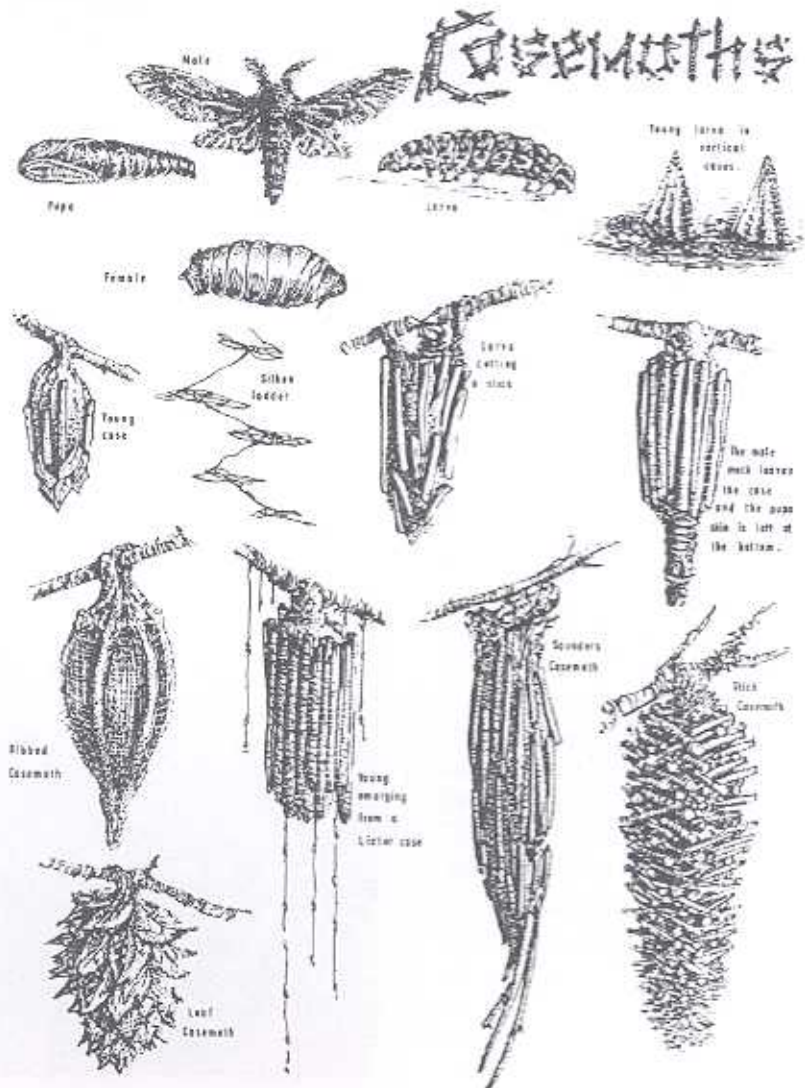
### WHO LIVES IN A HOUSE OF STICKS?

No, it's not one of the Three Little Pigs! It's a case moth larvae.

Case moths belong to the family Psychidae, which has some 350 species. In most of these species, the caterpillar lives inside a mobile case made of an assortment of silk, leaves and twigs. Due to the different styles of design, the case alone can be used to identify which species a particular caterpillar belongs to.

An interesting point to note here is that only the males will become flying moths as adults, as the mature females generally do not form wings, and will remain in the cases to breed.

Below are some of the various designs of cases formed by the case moth caterpillars. The stick case moth is a species endemic only to the southwest of Australia, and is often found in bush remnants on the outskirts of Perth.



Drawings courtesy of the Education Department





## PRACTICALITIES



# THE CREATION OF AWATUKEE WETLAND

By Julie and Greg Bousfield

WE moved to our property near Perth some twelve years ago, wanting to lose ourselves in the natural bush of this rural retreat. Our five-acre property, called "Awatukee" (a Cherokee Indian word for "place of dreams"), consists almost entirely of natural vegetation over Bassendean sand, with sections of banksia woodland, kunzea thicket, heathland, and a wetland.

Originally, however, the wetland did not exist in the form it is in now. When we first moved here the wetland area was a shallow sumpland with a few native rushes, an extension of a much larger and deeper seasonal wetland that extended into several neighbouring properties. It was home to a number of tiger snakes, and little else as far as we could see.

As more people moved to the area their chosen landuses conflicted with the natural environment, which resulted in the clearing of vegetation and the infilling of much of the large wetland. So ten years ago we decided to modify our sumpland to cope with the increased runoff resulting from these activities, and to provide a similar habitat for those organisms that once existed in it. In effect, I guess what we really did was attempt to move the original wetland from a neighbouring property to ours!

Amidst our own speculations that we weren't really doing the right thing by nature, we went ahead and spent \$1200 on the hire of a D7 bulldozer, which we used ourselves.

The sumpland was dug out to a depth of about one and a half metres, although shallow flats along the edges were deliberately left. Much of the spare dirt from the operations was used to create two islands within the new wetland, while the rest was used to make a bank matching the

height of the neighbour's infilling along the edge of our property, so we could put a boundary fence up.

The ground water level has dropped over the years, probably because of the pumping stations scattered about the area to prevent flooding and subsidence of urban developments. We are finding that mature banksias are dying in large numbers, the reason as suggested by one neighbour is due to the sudden lowering of the water table, while the growth of young trees is occurring in areas that once would have been much too wet for them. Once we could dig down two feet and hit water, but now the soil is bone dry.

Our speculations that we weren't doing the right thing in creating the wetland have been somewhat diluted by the modifications that are occurring in the area as a result of urbanisation. Our sumpland, had we left it, would now probably be no more than a large, empty patch of dusty sand.

Having completed the structure of the wetland, we decided to plant

a few non-endemic plants on the islands, and had great inspirations to create a romantic lakeside gazebo surrounded by lush lawns. However, as we learnt, nothing grows better in an area than the plants that are actually meant to be there. So while we watched our planted trees and romantic dreams die, the native rushes and scrub hastily covered the area to create a habitat denser than the original one, leaving very little for us to do in the way of revegetation.

Over a ten year period we have seen the number of visitations by water birds to the wetland increase, and have observed pairs of ducks (possibly the Pacific black duck) breeding each year on the islands. More recently, ibis have started visiting "Awatukee" as well. There are also long-necked tortoise, gilgies, and heaps of frogs that call the wetland home. Of course, the tiger snakes still live here!

*Julie and Greg Bousfield are keen wildlife observers, and are members of Land for Wildlife.*



*Julie and Greg in the cab of the D7 bulldozer, constructing the basin of the wetland (1988). Photo courtesy of Julie Bousfield.*



## FAUNA

# MARY CARROLL PARK WETLAND FROM A WATER BIRD CONSERVATION GROUP PERSPECTIVE

*by Joan Payne*

LIKE most urban freshwater wetlands, Mary Carroll Park in Gosnells has been substantially modified, reduced in size, used as a rubbish tip, nightsoil dump, orchard, market garden and piggery and is currently a compensating basin (or a stormwater sump). Most of the catchment was until very recently on septic tanks.

Mary Carroll Park contains two separate waterbodies, which provide habitat and refuge for a large range and number of waterfowl species. It is also a System 6 area and supports internationally important wading birds. It was once known locally as Kurtz' Swamp, but later renamed after a well-respected local identity Mary Carroll, who taught at the nearby primary school and used the wetlands as an educational resource for her students.

In the mid 1970's Mary Carroll Park was extensively modified. Islands were created to provide refuge and nesting areas, and a causeway which projects into the main lake built. A Concept Plan highlighted the conservation values of the wetlands and the likelihood of botulism occurring if modification created pools of stagnant water.

One of the more innovative aspects of the modification was the creation of a fenced wildlife sanctuary, with the more densely vegetated part of the northern lake being inaccessible to the public. Even today the debate, about excluding the public to facilitate breeding and provide a sanctuary for wildlife, continues. Yet the exclusion of the public from parts of Mary Carroll Park continues to be well accepted by the local community and supported by the Gosnells Council.



*Ibis.*



*Heron.*

*Photos courtesy of Joan Payne.*

A number of ornithological studies were carried out. One of particular note by Colin Heap from the Waterbird Conservation Group, involved regular bird counts over a 15 month period. These studies concluded that Mary Carroll Park supported the second largest population of black ducks in the metropolitan area. A diverse range of waterfowl frequent Mary Carroll Park, including musk duck, blue-bill duck, yellow-billed spoonbill, great crested grebe, hardhead, white-faced heron, little pied cormorant, moorhen, black fronted dotterel and red-capped dotterel. Greenshank, an internationally significant wader has also been recorded there.

For Waterbird Conservation Group members, involvement with Mary Carroll Park Lake began in the summer of 1984 when a severe botulism outbreak occurred and hundreds of birds died. At the time

there were many theories as to why birds were becoming paralysed and slowly dying, including chemical poisoning. The difficulty in determining whether waterbirds are dying from botulism stems from the need for expensive, sometimes exhaustive, and not always conclusive tests, of a number of live birds in the early stages of the sickness. The Group does not generally support the testing of live birds and continues to diagnose on the basis of symptoms and the birds response to treatment. Over the next few years small botulism outbreaks continued at Mary Carroll Park during the summer months, but in 1987 a severe outbreak occurred which involved over 1,000 casualties. It was established through testing that botulism was the cause.

After the 1987 botulism outbreak, the Gosnells Council stung by criticism of their management practices, established a Working Group which included members of the Waterbird Conservation Group and experts from the Environmental Protection Authority and Water Authority of Western Australia. A nutrient study was carried out by Rodda and Deeley. This study concluded that Mary Carroll Park was nutrient enriched and recommended urgent action to improve the water quality, including the preparation of a community based management plan.

A Management Plan prepared by Pedersen and Conacher, University of Western Australia, was released in 1991. This Management Plan was well received by the Waterbird Conservation Group and the local community, and its actions are currently being



# FAUNA

continued from page 9

## Mary Carroll Park, Gosnells

### Summary of Waterbird Casualties From 1985 to 1991

| YEAR | TOTAL NO. CARCASSES | TOTAL NO. RESCUED | REHABILITATED & RELEASED | TOTAL AFFECTED |
|------|---------------------|-------------------|--------------------------|----------------|
| 1985 | 100                 | 63                | 36                       | 163            |
| 1986 | -                   | -                 | -                        | -              |
| 1987 | 682                 | 342               | 251                      | 1024           |
| 1988 | 150                 | 55                | 44                       | 205            |
| 1989 | 412                 | 303               | 226                      | 715            |
| 1990 | 38                  | 34                | 29                       | 72             |
| 1991 | 106                 | 25                | 15                       | 131            |

#### SPECIES AFFECTED TOTAL: 24

|                       |                         |
|-----------------------|-------------------------|
| Black Duck            | Eurasian Coot           |
| Grey Teal             | Musk Duck               |
| Purple Swamphen       | Blue-billed Duck        |
| White-faced Heron     | Rufous Night Heron      |
| Moorhen               | Hardhead                |
| Pied Stilt            | Great Egret             |
| Sacred Ibis           | Yellow-billed Spoonbill |
| Mountain Duck         | Little Pied Cormorant   |
| Black Swan            | Little Black Cormorant  |
| Blue-winged Shoveller | Black-fronted Dotterel  |
| Chestnut Teal         | Little Grebe            |
| Wood Duck             | Feral Duck              |

implemented. Council budget allocations to address water quality problems and implement the Management Plan have continued each year. The Working Party, of which Waterbird Conservation Group is still a member, meets regularly and has recently overseen an infill sewerage project which will undoubtedly result in long term benefits for groundwater and wetland water quality.

## BOTULISM

Botulism is a bacterial poisoning, not an infection. The organism responsible, *Clostridium botulinum* produces a paralysing nerve toxin. When conditions in the wetland are favourable - warm temperature, high nutrients and low oxygen - the spores (which may have been lying dormant) germinate and multiply and a potent nerve toxin is produced. Birds swallow the toxin (usually in food) and absorb it through the lining of the digestive tract. The toxin enters the

blood stream and goes through the nervous system.

Botulism appears to affect all species in proportion to the numbers present. If birds are picked up in the early stages of botulism and treated, the prognosis is good for a full and fairly rapid recovery. At first birds lose the ability to fly, then to walk or swim. Unable to preen, they are increasingly susceptible to parasites such as leeches and blowflies. They become unable to eat or drink. Eventually the respiratory muscles become paralysed and the birds die. This agonising death can take many days.

A high percentage of birds will make a full recovery if treated promptly and correctly. They should be removed from the affected site, given a prepared solution, kept quiet and away from flies.

*Joan Payne is President of the Waterbird Conservation Group, and is contactable by phone on (08) 9371 1670.*

## Waterbird Conservation Group Inc

The Waterbird Conservation Group Inc. is a voluntary organisation formed in 1984 in response to a severe avian botulism outbreak at Thomson's Lake Nature Reserve.

Each year dedicated members and supporters assist in the rescue of sick birds and their rehabilitation.

As the pressures on our wetlands have become greater, so too have the demands on our members. We recognise the critical role which healthy habitat plays in maintaining healthy and diverse waterbird populations. Consequently the Group has a keen focus on the preservation and wise management of all wetlands in Western Australia. The Group is unique, in that it fulfils both conservation and waterbird rescue and rehabilitation roles. The Group is concerned for the welfare of the individual bird as well as for the survival of the wild population as a whole.

*(extract from the Waterbird Conservation Group brochure)*

The Group has put together a set of educational notes on the following:

#### What is Avian Botulism?

A special Message for Wildlife Rescuers and Carers (Hygiene Warning)

Artificial Feeding of Waterbirds  
Domestic/Feral Ducks in Wetlands

These notes are made available to local government and the public upon request.

For more information you can ring Joan Payne on (08) 9371 1670, or write to:

The Secretary  
Waterbird Conservation Group Inc.  
7 Carson Court  
GOSNELLS WA 6110



## FLORA

### WETLAND RUSHES AND SEDGES

By Kathy Meney

**M**OST people probably associate wetlands with tall, soft-grey flooded gums, mystical paperbarks, and perhaps a host of colourful flowering wet heath shrubs such as *Astarteas*, *Kunzeas*, *Pericalymmas*, all of which we usually know to generic level. Then we usually have a leftover bag of rushes, sedges, or 'reedy things', which have an ugly duckling reputation, a mysterious ecology and a downright unforgiving taxonomy. We usually can't even pick the families in many cases.

Well, lets take a different perspective on these super-subtle plants. This difficult group of emergent macrophytes are among the best indicators of microsite variation in a wetland, with changes in dominance reflecting soil type boundaries, hydrological variations, nutrient levels, organic matter content, pH changes, salinity, light penetration and many other ecological variables. The zonation of individual species often reflects spatial changes on the scale of centimetres, which are closely linked to rooting depth, hydroperiod and waterlogging/drought stress tolerances. Once you strike up a relationship with these plants, you should be able to pick a eutrophic wetland from a nutrient-poor one, a mineral-based wetland from an organic one, and pretty well mark the true wetland boundary by their distribution. You can't get that from a paperbark!

The wetland rushes, sedges and reeds fall into four main families, Typhaceae, Juncaceae, Cyperaceae and Restionaceae. Most will be familiar with Typhaceae, which comprises the introduced and highly invasive species, *Typha orientalis* alongside our native species, *Typha domingensis*. These bulrushes or 'cumbungi' are true reeds,



*Leptocarpus scariosus*  
Photos courtesy of Kathy Meney.

distinctive by their large chocolate brown inflorescences and strap-shaped leaves. They are classic indicators of nutrient-enriched environments, resprout rapidly after fire, have high seed viability (usually 80 - 90% in *T. orientalis*) and an extraordinary high growth rate. *Typha orientalis* is the supreme weed in the wetland of the south-west, limited only by salt, phosphorus and permanent water.

The Juncaceae are a diverse group of rushes, which are characterised by terminal usually compound inflorescences, comprising massive amounts of small seeds within papery capsules. The shore rush, *Juncus kraussii*, and pale rush, *J. pallidus*, are among the most common species in the south-west. These plants rarely occur in permanent water, but range from permanently moist to seasonally wet habitats. Many are salt-tolerant, and all flourish in nutrient-enriched conditions. They are usually dominant in organic-based wetlands.



*Baumea articulata*

The Cyperaceae are the sedges, which are a large and complex cosmopolitan group. Many wetland species are serious weeds in WA. The most common genera in wetland habitats are *Baumea*, *Lepidosperma*, *Schoenoplectus*, *Carex* and *Cyperus*. The sedges are an interesting group because of their diverse biology and habitat requirements. The genera *Baumea*, *Lepidosperma* and *Schoenus* are infamous for their



A number of readers commented that they liked this segment in the second-last issue, so ...

*Another extract from that Conference held on 23rd March 1921 to decide whether certain fauna should be declared vermin*

### THE DOMESTIC CAT GONE WILD:

Mr Crawford [Chief Inspector of Rabbits] said that he was responsible for having the cat gazetted as protected. There was no doubt cats did a great deal of destruction, and in certain districts were responsible for keeping the rabbits down. For a good many years past he had noticed that many of the native birds had practically disappeared, and he had very serious doubts as to the advisability of protecting the domestic cat. He referred to the great destruction that was going on in the mulga in the Upper

## THE WAY WE WERE ...



Murchison and the Gascoyne. It appeared to him that it was due to a beetle that bored into the roots. He had had some roots examined and in every case there were or had been "bardies" in them. Formerly the natives had been the principal check, but they had disappeared. Other checks were the butcher-birds, magpies, crows etc. Most of these were now being killed by cats, as also were the other insectivorous birds, ground larks, pipits etc. which were being destroyed wholesale.

The conclusion he had come to was that, though the cat may do a considerable amount of good in the destruction of rabbits, the evil it did was far greater. He thought that if the continual decrease, and even extermination, of our insectivorous birds continued, the insect pests would become quite as bad as the rabbit.

Mr Clarke [Forestry Department] confirmed Mr Crawford's remarks regarding the destruction of the big mulga.

The motion "That the Domestic Cat gone wild will be declared vermin" was carried.

*(Hmmm ... not sure about the ecological inferences here - do cats really eat butcher-birds, magpies and crows? ... And the decline in Mulga should surely be attributed to overgrazing by sheep? - Ed.)*

*Notes recorded in the Journal of the Royal Society of Western Australia, 1921.*

*continued from page 11*

difficulty to propagate, due to extremely low viable seed production rates (sometimes no more than 10-20 seeds per plant), and low germinability (10-30%). These species can now be grown well via tissue culture, using extracted embryos.

In contrast, *Carex*, *Schoenoplectus* and *Cyperus* species generally produce abundant seed, as well as maintaining a strong clonal growth ability, which will germinate readily if sown in high temperature conditions. It is of interest that the poor seed producers are generally associated with more nutrient-poor habitats and may reflect a preferential shuffling of scarce resources to rhizomes, which ensures perpetual growth, rather than to seeds. However, there are certainly some species which have suffered genetic bottlenecks due to isolation and fragmentation of wetland habitats, which has reduced

the ability of these wind-pollinated species to cross-pollinate.

A final and most remarkable group are the Restionaceae, also commonly referred to as rushes. They are often confused with the Cyperaceae, but are readily distinguished by a divided leaf sheath (sedges are tubular), and most have nodes along the culm. They are invariably associated with nutrient-poor, mineral-based wetlands, and are widespread along the south-coast. Most species are confined to the seasonally wet zone of basin wetlands, tolerating temporary flooding (usually 3 months) and summer drought. Other riparian species, such as *Meeboldina coangustatus*, occur in the bed of permanent or seasonal streams and rivers. Some are resprouters, but most of the wetland species are seeders. Because this group occurs in an environmentally extreme wetland zone, the species

diversity is higher than within the permanently wet zone, where only a few species dominate over large areas. Unfortunately, this wetland zone is also frequently cleared, and many Restionaceae have virtually disappeared from urban wetlands.

The trick to identifying the Restionaceae is to buy the identification guide, due to be released in September this year. Until then, don't ignore the rushes and sedges in your wetland vegetation surveys, and have a second go at identifying them. If you want some of the elegant species for your garden or for wetland rehabilitation phone Regeneration Technology on 9451 0830 for a copy of our species list.

*Dr Kathy Meney is a Director of Regeneration Technology and a Senior Research Fellow at Kings Park and Botanic Gardens. She can be contacted on (08) 9451 0830.*



## FAUNA

## CURIOUS COSSIDS

by Bob Huston

**H**AVE you ever noticed black cockatoos ripping away at the bark on eucalypt trees and wondered why, when normally the birds would be more interested in the eucalypt fruit? The answer is possibly that they are hunting for the larvae of cossid moths. The larvae are a well-known bush tucker delicacy we more familiarly know as witchetty grubs.

Exploring your local bushland can reward you with a multitude of wonderful surprises, as discovered by Murray and Sandy Kay (*Land for Wildlife*) when they chanced upon a magnificent cossid moth. To chance upon this heaviest of Australian moths is not an exaggeration by any means – the moths' camouflage is so near to perfect it is almost impossible to find them. Unfortunately for Sandy and Murray, this particular specimen was not alive when they found it lying on an open patch of ground.

Cossid moths, which belong to the family Cossidae, are known by a variety of common names, including wood moths, Christmas moths and goat moths. They are quite huge in comparison to other moths, having large fat bodies and a wingspan of up to 240mm.

Male moths find females by detecting the pheromone (scent) released by the females. After mating, the female cossid moths, like many females of the insect world, have the arduous task of laying an enormous number of eggs (up to 18,000) onto food plants or into woody crevices. The larvae begin feasting as soon as they emerge, boring tunnels through wood. Some species of cossid moth



*A cossid moth demonstrating the effectiveness of its camouflage against the bark of a tree.  
Photo courtesy of Bob Huston.*

tunnel into wattle roots (wattle moths) while others eat into the trunks of various eucalypts (wood or goat moths). They will continue eating and tunnelling through wood until they reach maturity, which can take as long as five years, and pupate into an adult moth.

Before pupating, the larva makes an exit hole in its tunnel to the outside world, and plugs it with fibrous material and silk. After pupating, the pupa pushes this plug out of the tunnel as it emerges, before undergoing the final moult into an adult moth. Once emerged, the new moth must vibrate its wings for a moment to ensure that the wing

muscles are at a high enough temperature to enable flight. The moths are most likely to be seen flying by observers just after the first rains of winter. Adult moths do not feed. Their main function is to find a mate and breed, soon after which they die.

Cossid moths have a host of natural enemies at all stages of their lives, such that a great number fall prey to predators, parasites and disease. Thus only a small number of the thousands of eggs laid by the female cossid survive to maturity, and an even smaller number live long enough to find a mate and breed.

Adult cossid moths are preyed upon by birds such as tawny frogmouths. Birds as small as the red wattlebird have been observed wrestling with cossid moths, eventually killing them and then trying to consume such a large meal.

The cossid moth larvae provide excellent nourishment for mites, spiders, wasps, other animals and especially birds. Carnaby's black cockatoo is occasionally seen sitting in a tree with its head tilted toward the trunk. Though comical to observe, it is thought that these birds are listening for the movement of cossid moth larvae beneath the bark, or perhaps trying to have a closer look at the trunk for visible signs of larvae activity. Once evidence of larvae has been found, the birds will rip away at the bark of the tree (see *Bush Detective*, WW vol2no1) to expose the tasty morsels, and then feast on them with relish!

*Bob is an ORCO working from CALM in Murrumbidgee. He is contactable by phone on (08) 9295 1955.*



## RESEARCH

## LARGE WOODY DEBRIS ARE IMPORTANT HABITAT IN RIVERS

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

**L**ARGE 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 table 1).

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.

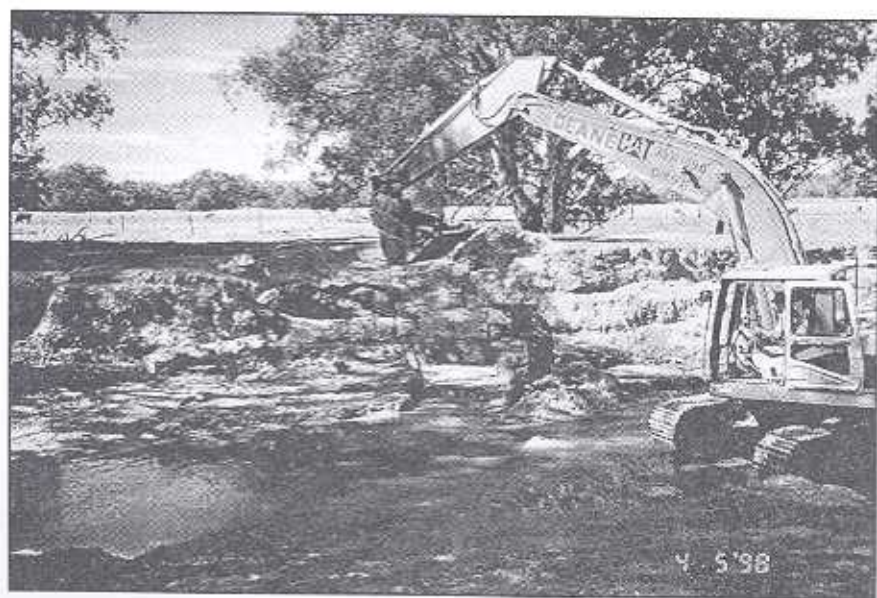
Branches extending into the water column and above the water

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 peelii*), 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    |
|                     | - above bed          | Scour pool           |
|                     | Scour pool           | Scour pool           |



## RESEARCH

continued from page 14

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 *Perithia 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<sup>3</sup> for every m<sup>2</sup> 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.

*Peter Davies and Andrew Storey are Research Fellows in the Department of Zoology at the University of Western Australia, working on ecology and management of streams and rivers. They are contactable on (08) 9380 2227, or by email (awstorey@cyllene.uwa.edu.au, pdavies@cyllene.uwa.edu.au).*



## COMING EVENTS

### ▷ PROPERTY PLANNING COURSE

To be hosted by Greenskills and Men of the Trees. The next one to be held will be on the weekend of August 8-9th. For further information please phone Basil Shur on (08) 9848 1019.

### ▷ DOWERIN GOLDEN WEST MACHINERY FIELD DAY 1998

August 25th, 26th and 27th. The show promises a wide array of the latest in farm machinery, as well as craft stalls and various other displays. Look out for the Landcare pavilion, which will host a combined display between *Land for Wildlife*, Threatened Species Unit and Murdoch University, Greening Western Australia, Roadside Conservation Committee, CALM Wheatbelt Region, and the Environmental Weeds Action Network.

### ▷ RIVER RESTORATION WORKSHOP

September 14th at Katanning. More details can be obtained by phoning Antonietta Davey at the Water and Rivers Commission, on (08) 9278 0300.

### ▷ FARM TOURS

Several events throughout the southwest have been organised by the Land Management Society.

September 14th Agroforestry and Farm Forestry, Bridgetown.

September 21st Autoharvesting, Frankland.

October 12th Agroforestry and Farm Forestry, Bridgetown.

The Land Management Society are contactable by phone on (08) 9450 6862 for more information and bookings.

### ▷ KINGS PARK AND BOTANIC GARDENS WILDFLOWER EXHIBITION

September 18-28th (including the long weekend). There will be a fantastic display of both native and garden flowers, with this year's theme being "Beauty and Nature Nurtured". A range of fun activities is available, so grab the family and a picnic, and head down to the park for a pleasant day out. For further information, activity costs and guided tours, phone the Kings Park Board on (08) 9480 3600 during business hours.

### ▷ PERTH ROYAL AGRICULTURAL SHOW

September 26-October 3rd.

### ▷ WEEDBUSTERS WEEK

October 5-9th. Assist with tackling the problem of environmental weeds. Phone Judy Fisher for more information on (08) 9385 9973.

### ▷ BUSH REGENERATION COURSES

Two courses are available through APACE Aid Inc., Saturdays August 1-September 26th; or Monday-Thursday October 13-16th. Courses will be held at APACE in North Fremantle, and a deposit of \$30.00 is needed to confirm your booking. Please phone the office during business hours on (08) 9336 1262 for further details or bookings for either course. Introduction to Bush Regeneration, cost of course \$200.00.

### ▷ WATER WEEK

October 18-24th. Phone Kathleen Broderick on (08) 9278 0717 for more details.



## NEW BOOKS

### A FIELD GUIDE TO INSECTS IN AUSTRALIA

by Paul Zborowski and Ross Storey  
Reed Books Australia, 1995

This book will help you identify Australian insects to at least Order level with reasonable accuracy and minimal knowledge. All 26 orders and many of the 661 families of Australian insects are covered, with detailed diagrams and lots of colour photos. The book also has a section on insect appearance, life cycles, anatomy and classification, and a glossary of terms. A Whitley Award winner, and a must for people who spend a lot of time with nature!

Cost: \$29.95. Available from bookstores.

### A GUIDE TO WETLAND INVERTEBRATES OF SOUTHWESTERN AUSTRALIA

by Jenny Davis and Faye Christidis  
Western Australian Museum, 1997.

Full of diagrams and colour photos, this is the perfect book to use for easy identification of aquatic invertebrates, many of which are often not noticed because of their diminutive size.

From water mites to mayfly larvae to mussels to marron, the book covers all recorded species found in the southwest of Western Australia, and contains comprehensive details for easy and fast identification.

Cost: \$29.95. Available from the Western Australian Museum bookshop.

This Newsletter is a compendium of articles written by many different people. The views expressed are those of the authors, not necessarily those of the Department of Conservation and Land Management.

Published by the Department of Conservation and Land Management, Perth. All correspondence should be addressed to: The Editor 'Western Wildlife', CALM Wildlife Branch, Locked Bag 104, Bentley Delivery Centre, WA 6983.

Design and Desktop publishing by Louise C. Burch Graphic Designer.