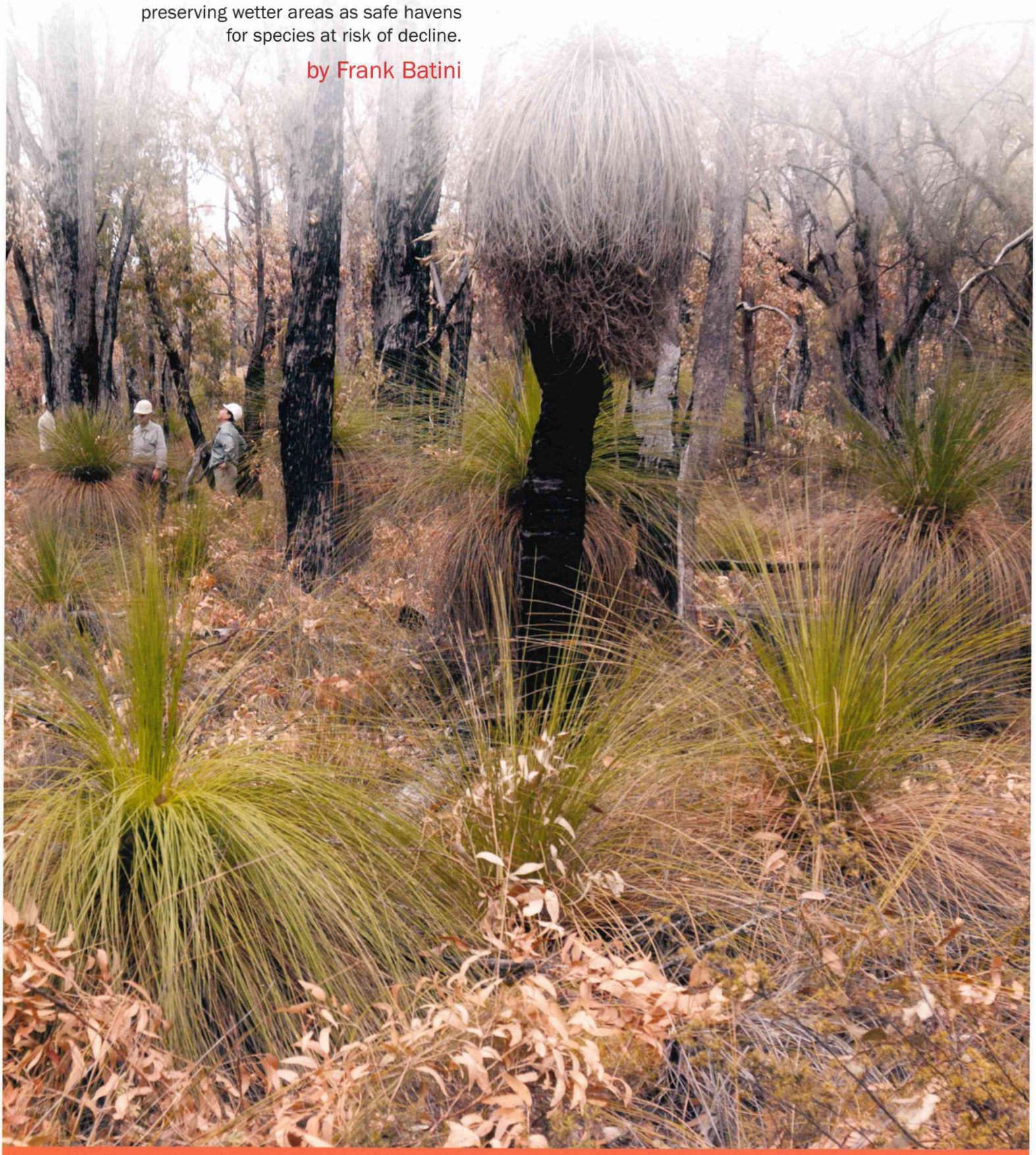
Dry times in the northern jarrah forest

A drying climate and the resulting changes in hydrology spell bad news for the future biodiversity of the northern jarrah forest. But there may be hope in preserving wetter areas as safe havens for species at risk of decline.

by Frank Batini



The hydrology of the northern jarrah forest has experienced several changes during the past 30 to 35 years. Rainfall has reduced by about 15 per cent and is forecast to drop further. In addition, watertables have fallen by about half a metre each year; base flow (groundwater which contributes to the water in streams during dry months) has decreased and stream flows have plummeted by up to 50 per cent. In some cases, streams which used to flow year-round are now dry for several months. These changes are due in part to lower rainfall, but also to the continued growth of the forest canopy in areas not recently logged and those that have been rehabilitated after bauxite mining, and to changes in the management of forests.

Water Corporation consultant James Croton has conducted modelling at three catchment areas near Jarrahdale —31 Mile Brook, Chandler and Cobiac—to project similar rainfall patterns from the past decade continuing into the future. The results show that, without any silvicultural intervention, there will be further declines in stream flow, catchment soil storage and groundwater levels in all three catchments. This is likely to lead to groundwater disconnecting from water systems above ground.

31 Mile Brook catchment

31 Mile Brook catchment was gauged between 1985 and 1998 and then again between 2006 and 2010, with an average annual rainfall of about 1,150 millimetres recorded. This catchment has not been greatly disturbed by bauxite mining or large-scale logging for many years and was studied in detail by forester Joe Havel in the early 1970s. Joe collected data on a grid pattern for slope, soils and rock outcrops, and examined the extent of dieback disease, tree density (basal area), indicator tree and understorey species distribution and, most importantly, he produced a vegetation map.

Since 2008, CSIRO researchers have conducted experiments on transpiration, soil moisture, groundwater and soil evaporation within this catchment, on strips that have been thinned, as well as in untreated controls. The Forest Products Commission has recently thinned a small (10 per cent) area in the upper part of the catchment.

This catchment is a very useful experimental area where the predicted impacts of hydrologic change on biodiversity can be evaluated. The modelled results showed that water tables that discharged into streams (base flow) in 1974 were forecast to drop to between four and eight metres below ground level by 2076. Streams that flowed year-round in 1974 flowed for seven months in 2008 and are predicted to flow for only four months in 2076. Essentially, this means that while the streams in this catchment were previously fed by both rainfall and groundwater, they are now fed just by rainwater.

Impacts on biodiversity

Such changes in hydrology are expected to have an impact on the biodiversity in the area. A major reduction in the period of stream flow and the drying of perennial streams will affect aquatic invertebrates that have long life cycles. There will be shifts in species richness, abundance and food chain organisation. These changes and loss of some species are already being recorded by sampling work carried out for the Water Corporation by The University of Western Australia's (UWA's) Andrew Storey. The drying

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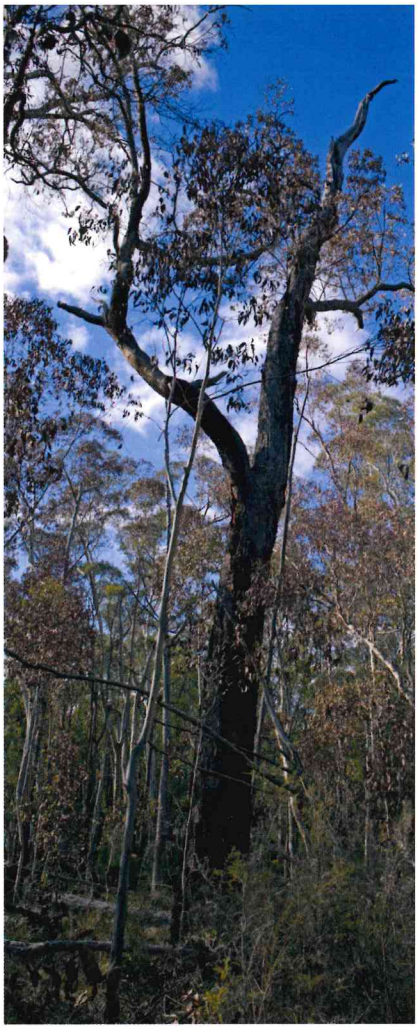
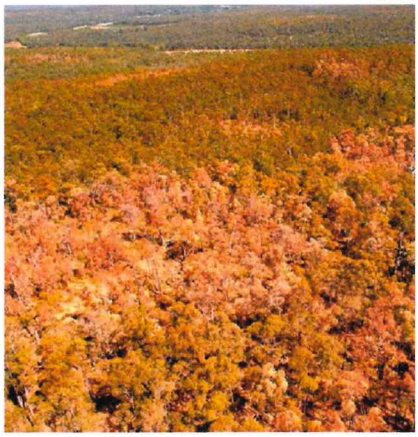
Native forest under stress in the Wungong catchment.

Left A dry water point in 31 Mile Brook.
Photos – Keith Barrett/Water Corporation





Above DEC's Frank Bailey with Curtin University environmental studies students.
Photo – Rima Itani/Water Corporation

Above right Bullich dying around a large dead marri tree in the Chandler catchment.
Photos – Keith Barrett/Water Corporation

Right Recent tree deaths in the Wungong catchment.
Photo – Des Birt/Water Corporation

of streams and of major pools will also undoubtedly affect the survival of some species of fish and crustacean that are dependent on these habitats. However, UWA studies have not yet recorded any changes.

Vegetation is also set to suffer. The current distribution of plant species that grow alongside streams—known as riparian vegetation—has developed under conditions where the near-surface groundwater was actively discharging into the stream, increasing streamflow and maintaining it well into the drier summer months. Once the groundwaters become disconnected, the lack of water is likely to lead to a reduction in the range and number of plants as well as localised species extinctions.

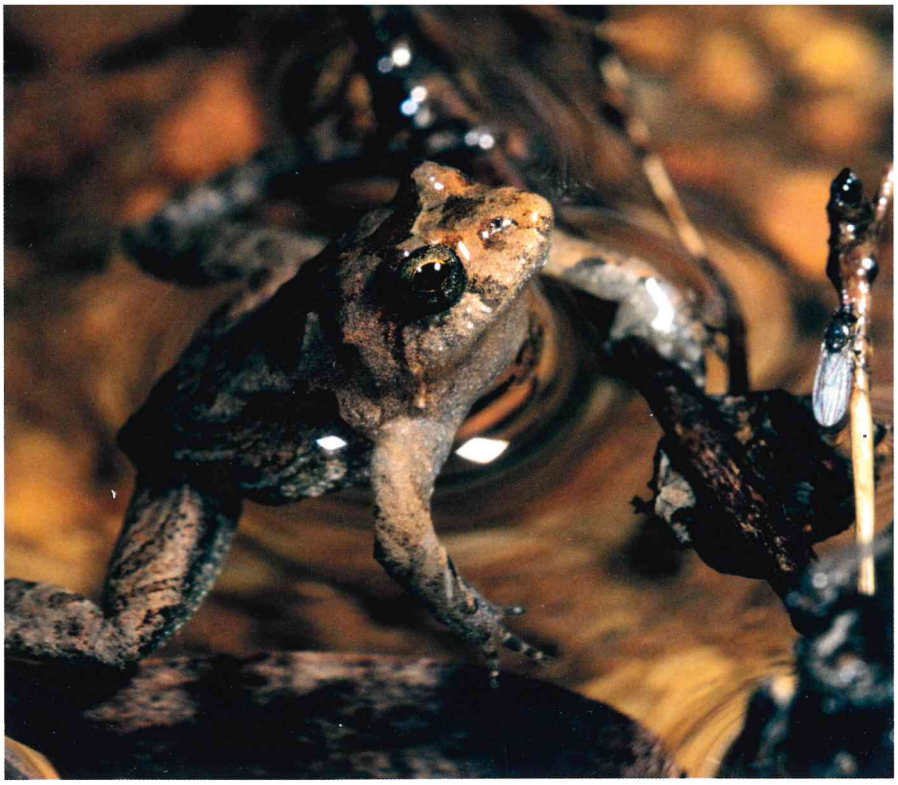
The riparian species most likely to be affected—blackbutt (*Eucalyptus patens*), bullich (*E. megacarpa*), flooded gum (*E. rudis*), river banksia (*Banksia littoralis*) and paperbark (*Melaleuca preissiana*)—already have a very restricted range within the northern jarrah forest. The most likely impact on understorey species will be on the very dense willow myrtle (*Taxandria linearifolia*) and *Astartea scoparia* swamps and wetlands that follow the creek lines.

Additionally, dry vegetation which provides fuel for fires will now be drier for longer and is more likely to burn more frequently and hotter. These fires will lead to the landscape being more open. A reduction in the extent and density of riparian vegetation will affect the vertebrate species that depend on these riparian habitats and will make some species more vulnerable to predation by cats (*Felis catus*) and foxes (*Vulpes vulpes*).

The current distribution of vegetation on slopes and uplands is determined by underlying factors such as landforms, soils, climatic conditions and soil moisture availability. With lower rainfall there will be a shift towards species which are drought tolerant. Forests (which have dominated the higher rainfall areas) could be replaced by more open woodland. Deaths of jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*) and associated species were obvious in summer 2007 and 2011, following dry winters in 2006 and 2010, especially on shallower soils.

Fauna under pressure

Western Australian Museum curator of ornithology Ron Johnstone has been monitoring bird populations in the forest within the Wungong catchment and has observed dynamic negative changes in status and abundance in



Above Red-eared firetail finch.

Above left Glauert's froglet (*Crinia glauerti*).

Below left Quenda.
Photos - Jiri Lochman

recent years. The species most likely to be affected are those that require dense riparian vegetation, such as the red-eared firetail finch (*Emblema oculata*), white-breasted robin (*Eopsaltria georgiana*) and golden whistler (*Pachycephala pectoralis fuliginosa*). In addition, most seed-eating birds that require access to water, such as the forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) and brush bronzewing (*Phaps elegans*), will also be adversely affected.

A number of mammals also require the shelter of dense riparian vegetation, particularly as a protection from predation. These include the mainland quokka (*Setonix brachyurus*) and the quenda (*Isoodon obesulus*). The water rat, or rakali (*Hydromys chrysogaster*), would also suffer from drier streams.

Many amphibians rely on standing water and moist soil to complete their life cycle. Reduction in the extent of riparian vegetation and reduced stream flow are very likely to disadvantage most frog species.

Possible havens

In all, some 25 to 30 species that occupy riparian and upland sites within the northern jarrah forest will be at risk from the hydrologic changes that have been observed and those that are predicted. Adverse effects have already been seen on the more sensitive species, such as some aquatic invertebrates, some bird species and trees growing on upland shallower soils.

But all is not lost. The maps of vegetation prepared by ecological consultant Libby Mattiske and forester Joe Havel define areas that may become refuges for certain species as the climate becomes drier. These include valley complexes known as 'Helena', areas characterised by shallow soils associated with granite on steep slopes of valleys in the high rainfall zone. However, in many cases these areas now occur below sites that have been dammed for water supply and where the natural water regime has been disrupted. The major valley as yet without a dam is that of the Murray River. The valley of the Gooralong Brook below Jarrahdale is another example, as is the Serpentine River below the pipehead dam.

Valley complexes known as 'Murray'—found on the more fertile valley floors and slopes in the higher rainfall zone—may also act as future safe havens for some species. However, many of the better sites have been flooded by dam construction and now remain as narrow remnants on either side of the reservoir.

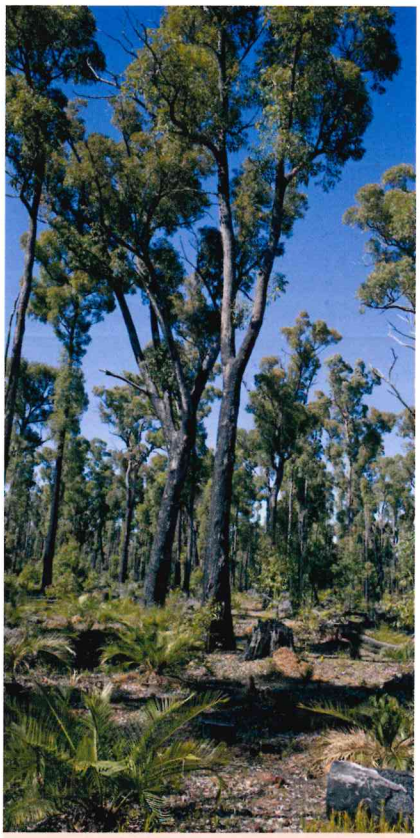
Above Bullich Swamp, Chandler catchment.

Right Healthy crowns in thinned native forest near Jarrahdale Road.
Photos – Keith Barrett/Water Corporation

Species retreating from drier areas may also survive in valley complexes known as 'Lowdon', which occur in the lower Collie, Brunswick, Harvey and Ferguson valleys and comprise of marri, jarrah and peppermint (*Agonis flexuosa*) forest with some wandoo (*Eucalyptus wandoo*) on slopes and flooded gum (*E. rudis*) and paperbark on valley floors in the higher rainfall zone. Some such valley complexes are located below existing dams and other parts are mostly in private property. Swamp complexes—which occur on seasonally moist or wet sand, peat or clay soils in valley floors, especially in the higher rainfall zone—will also become safe havens for some species. These are typical habitats for bullich, river banksia and paperbark and are well represented in parts of the Wungong, North Dandalup, Little Dandalup, Waroona, Sampson and Stirling Dam (Harvey River) catchments.

Management benefits

Saving biodiversity from the forecast hydrological changes will mean identifying suitable safe havens for plants and animals and actively managing them to enhance their value as refugia (also see 'Just add water: the Toolibin inundation' experiment on page 26). Management actions that could be considered include silviculture and regular prescribed burning. These can potentially reduce competition and increase the availability of water and nutrients to a forest ecosystem which is already under stress. Regular prescribed burning will also minimise the damaging effects of large-scale bushfires on fauna, erosion and nutrient loss. Riparian areas will require additional protection by baiting to reduce fox and cat predation. Near-stream areas will also need to be protected from weed invasion as well as any artificial spread of the *Phytophthora* fungus. Selected areas in the high rainfall zone (which receive above 1,100 millimetres a year) could be actively managed to maintain or improve soil moisture, watertables and to increase run-off into streams. This includes native forest, pine plantations and areas subject to rehabilitation after mining. With such safeguards, the plants and animals of the northern jarrah forest may survive in the face of an increasingly drying climate.



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