

FROGS

VALUE IN VARIETY

by Grant Wardell-Johnson and Dale Roberts

Photos - Grant Wardell-Johnson

Frogging is more than simply the idle pursuit of small children. Western Australia is home to more than one third of Australia's frog species, including some unusual ones that never enter the water. Two of these are the rarest frogs in Australia, and a team in the South West is working to save them.



Visit a swamp or river at night at any time of the year, and you will usually be treated to a chorus of frogs. In the south-west of Western Australia alone, there are at least 30 species of frog, displaying a remarkable variety of shapes, sizes and voices.

Unfortunately, widespread clearing of native vegetation in the South West is causing the decline of many species of frog, as plants are cleared from river banks and wetlands. However, different species have different habitat requirements; one frog's wasteland is another frog's paradise. Although clearing can encourage some frog species, resulting in an increase in the total number of frog species in a given area, it can also remove those that are most vulnerable. So should we be worried about frogs, and if so, which species should we be concerned about?

The frog fauna of the south-west of WA has been studied over many years, but there are still fundamental questions to address. In 1982, we set out to examine the distribution of and differences between members of the *Geocrinia* group of frogs, thought to occur only in a small area of karri forest in the South West. Two species were then known: the karri frog (*Geocrinia rosea*), described in 1927 and known to have a range centred on the Warren River catchment, and the Walpole frog (*G. lutea*), described in 1963 but only known from nine specimens collected near Walpole.

Detailed surveys revealed that the karri frog is widely distributed over the western portion of the main karri belt. The Walpole frog is found only at sites within a 12-kilometre radius of Walpole. Both species are common within their ranges, which are separated by a distance of about 40 kilometres.

NEW DISCOVERIES

Then, in 1983, we made an unexpected discovery. We were camped by the headwaters of a small creek in the jarrah forest near Boranup. Dusk arrived and the spring evening descended. A familiar but unexpected sound '... tk tk tk tk tk ...' came from the dense gully vegetation near the campsite. It sounded like the call of the karri frog, but karri frogs were thought to occur only in the main karri belt, 70 kilometres to the east.

Some careful listening and the



Previous page
The *Geocrinia rosea* group of frogs call from small depressions just beneath ground cover.

Top: The Walpole frog occurs only within 12 kilometres of Walpole.

Above: The orange-bellied frog is the most restricted vertebrate known from mainland Australia.

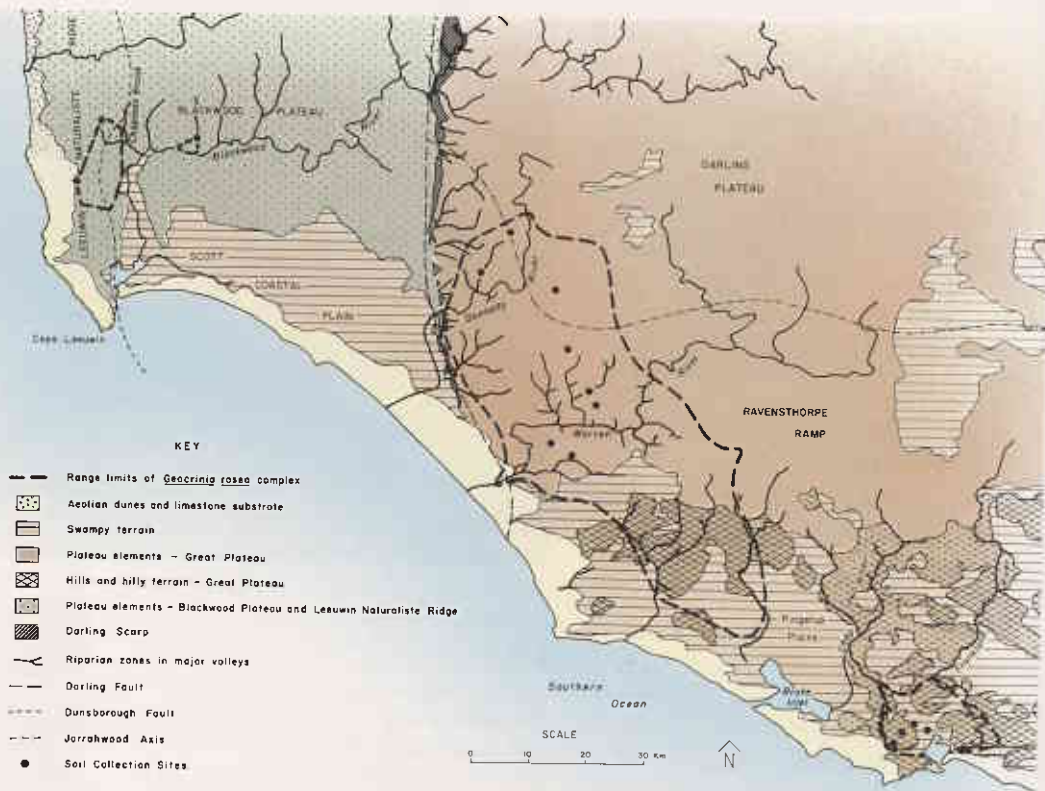
collecting of a few frogs revealed that these were not karri frogs; the new frogs were a different colour and had a distinctly different call. Further studies suggested that they were related to the karri frog, but distinct from it, and we named them white-bellied frogs (*G. alba*).

We later discovered an even more striking *Geocrinia* in the western Blackwood Plateau, which we named the orange-bellied frog (*G. vitellina*). Ironically, these two new frog species have turned out to be extremely rare, and are now on the threatened fauna list in

Western Australia. They are the only frogs in Western Australia to have this dubious honour, which puts them on a par with numbats, tammar wallabies and the noisy scrub-bird. It means that they are almost extinct, but not quite. They can still be saved.

LAND-LIVING FROGS

The geocrinias are small frogs, about the size of a thumbnail. The orange-bellied frog cannot be confused with any other frog species. About the front half to two thirds of the underside is bright



yellow-orange (hence *vitellina*, meaning the colour of egg yolk). No other frog species in Western Australia has such characteristic coloration.

The white-bellied frog is not so distinctive, but it does have some distinguishing features. The undersurface is white or very faint yellow and the skin is smooth. The back is light to dark brown with a series of raised dark spots forming distinct rows.

These tiny frogs shelter in damp peaty sites in tea-tree swamps, and you are more likely to hear their calls than to see the frogs themselves. Frogs call to attract mates. Generally only males call. The calls of white-bellied and orange-bellied frogs are similar and may be difficult to tell apart. They both consist of a series of short clicks, each click like the sound made by pulling your tongue sharply away from the roof of your mouth. In the orange-bellied frog, the call averages 11 clicks per burst. The call of the white-bellied frog is slightly longer, averaging 15 clicks per burst. The rate of clicking is only just slow enough to count and changes with temperature; warmer frogs call faster.

White-bellied and orange-bellied frogs call in spring to early summer, with peak activity in September and October. Males do not call from water, but from moist ground that may be very close to

streams. They are usually extremely well hidden among vegetation.

Members of the *Geocrinia* genus are unusual in that they do not enter the water. Many frogs deposit their eggs in water. These hatch and the free-swimming tadpoles feed, grow and eventually metamorphose into frogs. *Geocrinia* species do things differently. They deposit their eggs in small depressions in moist soil, hidden under litter or dense vegetation. The eggs hatch and the tadpoles go through their entire development in the jelly surrounding the eggs. They do not feed, but rely on food reserves in the egg yolk. This is known as direct development. Although unusual, this sort of life-history is shared by some other Western Australian frogs.

Because of their breeding biology, geocrinias are commonly associated with creek systems, particularly those having soil with a high organic content that do not readily dry out over summer. But clearing of native vegetation for agriculture has left few suitably damp frog swamps in the domain of the white-bellied frog.

The white and orange-bellied frogs are two of the most geographically restricted vertebrate species known in mainland Australia. They occur only in the high-rainfall region between Margaret River and Augusta. The orange-bellied

Above: The distributions of four members of the *Geocrinia rosea* group of frogs are separated by subtle landform and climatic barriers.

Below: Males of the Walpole (shown here) and Karri frogs have a distinctive black chin.



frog has a range of only six square kilometres, and the white-bellied frog occurs over an area of about 100 square kilometres. But within these two ranges, there are only a few areas suitable for breeding—as little as 0.2 square kilometres for the orange-bellied frog and 1.9 square kilometres for the white-bellied frog.

WHAT CAN WE LEARN FROM THE FROGS?

The discovery of four different forms of *Geocrinia* added to the debate over the formation of new species in the South West.

One of the mechanisms involved in the evolution of new species from a common ancestor is the geographical isolation of individual populations by events such as the formation of a mountain range or encroaching sea. Such isolated pockets of a species continue to evolve independently from one another over time, becoming gradually more different. If this is the case, how did so many different species of frog arise in the South West, where there are no major geographical barriers to isolate populations? Until the 1980s, it was thought that the high species diversity of frogs in the South West could only be explained by postulating another mechanism for the formation of new species. It was thought to have been due to successive migrations of eastern Australian stocks across the area that is now the Nullarbor Plain, and their subsequent differentiation.

WHAT MAKES A SPECIES?

Having identified four sets of isolated populations of geocrinias, we needed to determine whether these forms were different enough from one another to be regarded as different species.

Species are generally defined as groups of interbreeding populations reproductively isolated from other such groups. Reproductive isolation might be caused by behavioural barriers. For example, in frogs, males call to attract mates. If there is a change in call structure, females may simply not recognise the call of males signalling with the new call and therefore not mate with them. Alternatively, different species may mate, but be genetically too different to produce viable embryos.



Above: The tadpoles of the *Geocrinia rosea* group of frogs go through their entire development in the jelly surrounding the eggs. Here, froglets of the Walpole frog are about to take their first steps into the outside world.

Right: The dense habitat of the orange-bellied frog.

Opposite page: Habitat of the white-bellied frog still exists within the agricultural landscape, but will not survive unless fenced.



One problem with determining whether these frogs can be defined as different species is that, where populations are isolated, we cannot say whether they would interbreed. The best we can do is to assess whether the differences between them would act as barriers to reproduction if they ever came into contact. Hence, we investigated differences in male call, differences in colour and shape, and levels of genetic differentiation between the four different geocrinias.

We concluded that, if the karri and Walpole frogs came into contact, they would probably interbreed, as there are few behavioural differences. Similarly, the white-bellied and orange-bellied frogs would probably interbreed. But there is little chance that the white-bellied or orange-bellied frogs would interbreed with the karri frog, as there are major call differences and significant genetic differentiation. Despite this, the four forms are sufficiently different to be regarded as four distinct species.

This shows that, even in areas with no

major geographical barriers, different frog populations can exist within a few kilometres of one another without interbreeding. The range of the karri frog is separated from that of the Walpole frog by 39 kilometres of swampy land that is dry in summer. The karri and orange-bellied frogs are separated by about 47 kilometres of rolling terrain including lateritic uplands, swamps and narrow stream channels. The ranges of the orange-bellied and white-bellied frogs are separated by nine kilometres of lateritic uplands and narrow valleys. This means that narrower, more subtle geographic barriers than had previously been envisaged may have allowed the evolution of many different species of frog in south-west Australia.

How long ago did these species become isolated? One can assess this at the molecular level by comparing the proteins of the different species. We estimate that the orange-bellied frog has been evolving independently from the karri frog for about 15.5 million years, and that the karri and Walpole frogs were

split about five million years ago. The formation of new species does not happen overnight.

BACK FROM THE BRINK

The restricted distributions of the white-bellied and orange-bellied frogs mean they are particularly prone to extinction. Their dependence on undisturbed permanently moist sites requires special conservation efforts directed at their habitats.

A recovery plan for these two species is now under way (see 'Bush Telegraph', *LANDSCOPE*, Summer 1992-93). The aim is to bring them back from the edge of extinction. The plan is being implemented by a team that includes members from the Department of Conservation and Land Management (CALM), the University of Western Australia, the Australian Nature Conservation Agency, the Augusta-Margaret River Shire and the local Land Conservation District Committee.

The first step in the recovery plan was to determine the distributions of the two

species in detail. This involved many nights spent in swamps during the breeding season, recording males calling. It has confirmed the restricted distributions of the two species.

The orange-bellied frog is confined to a small domain within State Forest to the north of the Blackwood River. Having such a small range makes this species particularly vulnerable. Its known calling sites are within a unique area of less than 0.2 square kilometres, which is like a damp oasis surrounded by a 'desert' of laterite. This site harbours many unusual species, including the distinctive locally endemic giant rush *Reedia spathacea*, the only member of its genus, as well as a host of previously unknown aquatic invertebrates.

The white-bellied frog is confined to a few sites in the Witchcliffe-Karridale area. Although some of the range of the white-bellied frog remains uncleared, much is privately owned and therefore subject to clearing for agriculture. We already know that clearing and grazing is inimical to the survival of these species.

The protection of suitable sections of creek will be essential to ensure the frogs' survival in areas of agricultural land.

We also need to know the stability of the populations of these species. The limited monitoring carried out in the past 10 years suggests that the populations fluctuate from year to year. An extensive monitoring program, which involves counts of calling males at several sites throughout the breeding season, is now in place, and will operate for the next 10 years. Although there is much discussion of the worldwide decline of amphibians, this is one of the few long-term monitoring programs to generate data to test this notion, and to address the causes.

One of the aims of the study is to determine what happens when the frogs' habitat is degraded or disturbed. We have learnt that fire in early spring does not burn the sites from which the frogs call, and does not affect the numbers of calling males that season. They hardly miss a beat. The fate of the females is unknown because their silence makes them almost



impossible to locate. But a fire in summer or autumn, when the creek vegetation is dry, burns their calling sites and no geocrinias can be heard that year, and perhaps for many years after. We do not know the longer term effects of fires, but this information is being gathered by tracing the fate of individual animals through fires.

ENLISTING THE COMMUNITY

Public participation in the recovery plan for these species is a critical step in their conservation. Action is needed, before it is too late, to take care of the stream zone habitat where the frogs occur. To spread the message, a 'recovery kit', newsletter, schools package and speaker's kit are being developed, and will be available shortly.

There are many things that people, including landholders, can do to help, and it has not proved difficult to enthuse the local community. There is a widespread appreciation of the broader benefits of the conservation of these tiny critters. Everyone seems to want a frog swamp on their land. The most important

step is the protection of stream zones from clearing or stock intrusion. A fencing program involving the landholders is under way, and many farmers are participating in the scheme.

Of course, fencing stream zones has many benefits besides frog conservation. It is helpful in farm planning because it divides the land up into more appropriate units by following natural boundaries. It also prevents the degradation of the streams and safeguards the many, as yet unknown, species and rare communities of creatures that live there. It is not just the frogs that are important. The whole focus of the geocrinia recovery plan is the communities and habitats of which these creatures are a part.

These tiny creatures enable us to refocus our image of the pattern in the landscape of south-western Australia. It may lack big mountains, but it is a fine-scale world of great richness and variety.

Below: Both male (shown here) and female orange-bellied frogs have a distinctive yellow-orange chin and throat.

Grant Wardell-Johnson is a CALM Senior Research Scientist studying biogeography and endemism. He can be contacted at CALM's Wildlife Research Centre on (09) 405 5100. Dale Roberts is a Senior Lecturer in the Department of Zoology at the University of Western Australia. He can be contacted on (09) 380 2224.



Above: Fully-grown male white-bellied frog—one of several thumb-nail-sized frogs in the South West.



LANDSCOPE

VOLUME TEN NO. 1 SPRING ISSUE 1994

F E A T U R E S

PLANTS ON THE EDGE
GREG KEIGHERY & JOHN BEARD 10MAMMALS IN THE GARDEN
ANDREW BURBIDGE & TONY START 18CORAL FOR KEEPS: THE ROWLEY SHOALS
TERRY DONE, CHRIS DONE & CAROLYN THOMSON 28FROGS: VALUE IN VARIETY
GRANT WARDELL-JOHNSON & DALE ROBERTS 35RECOVERING LAKE TOOLIBIN
KATE HOOPER & KEN WALLACE 41STAR SWAMP
JOHN HUNTER 45THE COMPLEX COAST
HUGH CHEVIS 49

R E G U L A R S

IN PERSPECTIVE 4

BUSH TELEGRAPH 5

ENDANGERED THE WOYLIE 25

URBAN ANTICS 54

S P E C I A L S

ARBOR DAY POSTER COMPETITION 26



Yellow-billed spoonbills have visited Star Swamp for the last three years. They sift small crustaceans from the shallow water. The story of this suburban wetland is told on page 45.



A marine park is proposed to adjoin the Prince Regent Nature Reserve. The Complex Coast (page 49) discusses the need for integrated management of land and sea around our coast.



Found all over Australia, short-beaked echidnas are one of two Australian egg-laying mammals. They still occur around Perth. See page 18.



About a quarter of Stirling Range National Park has been closed to protect its unique flora from dieback disease. Turn to page 10 to discover these plants on the edge.



The orange-bellied frog is part of the South West's fine-scale richness and variety. Find out more about these fascinating creatures on page 35.

C O V E R

The coral gardens in the sheltered lagoons of the Rowley Shoals contain dozens of different varieties of staghorn coral and are inhabited by a huge range of colourful reef fish. See 'Coral for Keeps' on page 28.

The illustration is by Philippa Nikulinsky.



Managing Editor: Ron Kawallak

Editor: David Gough

Contributing Editors: Verna Costello, Kate Hooper, Carolyn Thomson

Scientific and technical advice: Andrew Burbidge, Tony Start

Design and production: Maria Duthie, Stacey Strickland

Finished art: Gooitzen van der Meer

Illustration: Gooitzen van der Meer

Cartography: Land Information Branch CALM, Promaco Geodraft

Marketing: Estelle de San Miguel ☎ (09) 334 0296 Fax: 334 0489

Subscription enquiries: ☎ (09) 334 0481

Colour Separation by Prepress Services

Printed in Western Australia by Lamb Print

© ISSN 0815-4465. All material copyright. No part of the contents of the publication may be reproduced without the consent of the publishers.



Published by Dr S Shea, Executive Director
Department of Conservation and Land Management,
50 Hayman Road, Como, Western Australia 6152.