Big hopes
for tiny frogs

Two tiny species of frog – the white-bellied frog and orange-bellied frog – are known from just a handful of precariously poised populations in the State's south-west. Work is being done to safeguard these populations and create new ones, so that these species will fill the spring night air with their calls from isolated creek lines for many years to come.

by Christine Taylor

A loud volley of clicks, like a toy machine gun, sounds out from amongst the moist leaf litter. The resultant pressure wave pounds into your ear canal and a ringing echo continues for a few more seconds. Despite how close it seems, it takes another 10 minutes to narrow down the exact location of the male white-bellied frog – the tiny creature that is making all the noise. He has carefully dug a small burrow from where he will call, night after night in spring, hoping to attract a female to lay her eggs. Unfortunately for him, in this instance, he has only attracted the attention of DBCA Parks and Wildlife Service officers, who are crawling along the creek line in the dark to monitor the population of this critically endangered species.

For DBCA staff, the annual 'Frogging' surveys, carried out over two to three months in spring, are intensive and at times challenging. But, since monitoring began in the early 1980s, this program has become one of the most comprehensive monitoring programs for any Australian amphibian species. And the dataset that has been collected over 30 years, is being used by researchers to determine the ability of the frogs to cope with changes in climate and hydrology, and to inform recovery actions to better protect the white-bellied frog (*Geocrinia alba*) and its close relative the orange-bellied frog (*Geocrinia vitellina*).

A VERY SHORT-RANGE ENDEMIC

The white-bellied frog and orange-bellied frog are tiny endemic frogs that inhabit narrow, densely vegetated creek lines south of the tourist town of Margaret River. They are unlike any 'typical' frog that people would be familiar with, in fact very few people would have ever seen or heard this frog calling from its isolated creek habitats.

Similar in appearance, both species are about 20 to 25 millimetres long with a light brown or grey dorsal surface, to camouflage with their muddy surroundings, and have a smooth white or orange belly. Given their small size, restricted territory, limited dispersal (the adult frogs rarely move more than one to five metres a year) and shallow burrow-dwelling habits, the frogs are very rarely seen – even by the researchers monitoring them!

It's not surprising then, that both *Geocrinia* species were only discovered in 1983. The orange-bellied frog was known from only six populations, across a species range of six kilometres and a total area of occupied habitat of approximately three hectares, all along the northern banks of the Blackwood River, making it a true micro-endemic. The white-bellied frog is slightly more widespread, and its population extends from Witchcliffe south to Karridale. However, many of the populations were already small and fragmented. Making things even more tenuous, subsequent research has revealed that each population has a unique genetic signature. This presents an immediate conservation challenge as the genetics of the source populations must be carefully considered before translocations and other population augmentation management actions are undertaken.

Unlike most frogs, *Geocrinia* species live and breed terrestrially, meaning they do not live in water and have no free-swimming tadpole stage. Instead, the males create a small, shallow burrow in moist soil, from where they call to females during spring evenings. Females then lay 10 to 12 eggs into the burrow, which the male fertilises and closes over. The male then moves a few centimetres away and digs a new burrow to repeat the process.

Previous page
Main Creeks around Margaret River are home to the critically endangered white-bellied and orange-bellied frogs.
Photo – Marie Lochman
Inset from left Orange-bellied and white-bellied frogs.
Photos – Kim Williams/DBCA

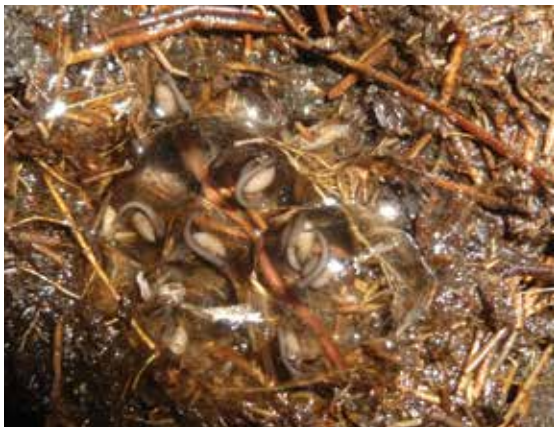
Above An orange-bellied frog from one of the newly discovered populations in 2016.
Photo – Christine Taylor/DBCA

Eggs are then left to hatch into tadpoles, which develop entirely within the jelly-like egg mass, only leaving the burrow when they metamorphose into tiny frogs that weigh no more than 0.04 grams (about the size of a single 'Rice Bubble') a few months later.

THREATENED AND DECLINING

As both species have extremely specific habitat requirements and a restricted and fragmented distribution, as soon as they were discovered there was concern about their ongoing conservation. Since then, the white-bellied frog has been listed as critically endangered and the orange-bellied frog as vulnerable under the Biodiversity Conservation Act. A recovery plan for both species was produced in 1994 with an updated plan released and endorsed by the State and Federal governments in May 2015.

Both species are threatened by the effects of direct habitat alteration, which is caused by factors such as fire, land clearing, damage by feral pigs and burial by



Top Eggs hatch into tadpoles and then metamorphosising into tiny frogs in shallow burrows in the ground.

Above Metamorphosising frog.
Photos – Perth Zoo

Above right Researchers undertaking microclimate measurements of soil moisture and temperature to better understand the frog's habitat requirements.
Photo – Brunno Buzatto

eroded sediments. In addition, significant changes in land use and groundwater levels, surface streamflow, rainfall and climate within the region are altering the hydrology of the headwater streams, and are causing breeding sites to dry up. Given the frogs' tiny size, reliance on moist environments and fragmented distribution, the loss of any population is likely to be permanent as, without intervention, they are not able to disperse long distances to re-colonise suitable habitat.

Though the white-bellied frog has the larger distribution, unfortunately most of its habitat (77 per cent of all known subpopulations) is on private land. Being in the heart of wine and tourist country, mapping has shown that up to 70 per cent of potential creek line habitat in the area has been cleared for agriculture, viticulture, tree plantations, dams and other purposes. While 114 subpopulations of this species have been identified 62 (54 per cent) are now unfortunately considered extinct and no new natural populations have been discovered since 2007.

Orange-bellied frog habitat has generally received less disturbance than that of the white-bellied frog, as all populations occur within the Blackwood River National Park and are therefore relatively safe from large-scale habitat modification. However, as with the white-bellied frogs, many of the smaller populations are still in decline and the ongoing drying climate in the south-west is reducing habitat sustainability.

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FROGGING 101

Crawling through swamps and creeks in the dark may not be everyone's idea of a regular Thursday night, but for a group of DBCA staff, waders and headtorches become standard springtime attire. 'Frogging' involves visiting populations at night, counting all calling males (females do not call) and recording other habitat parameters. As the sex ratio for the species is approximately 1:1, these data can then be used to monitor population size over time. At some sites, a population estimate is made each year, while others are monitored more intensely. Researchers do this by locating the first calling male then making their way downstream, counting each calling individual in the creek. This provides a measure of density and distribution, which can be repeated over time to detect changes in population size and the area of occupied habitat.

Hear more about the monitoring program

Scan this QR code or visit Parks and Wildlife Service's '*LANDSCOPE*' playlist on YouTube.

Above Both frog species grow to between 20 and 25 millimetres long.
Photo – Alex Cearns

Top right Collecting egg masses from wild populations to be head-started at Perth Zoo.

Above right The frogs inhabit narrow, dense creek lines south of Margaret River.
Photos – Emily Hoffmann

Above far right Researchers head out each spring to monitor populations.
Photo – Perth Zoo

Even after 30 years of intensive monitoring, the frogs are still providing surprises and challenges. In 2016, while searching outside the known range of orange-bellied frogs for suitable habitat to possibly introduce new populations, the research team stumbled across a steeply inclined basin swamp with vegetation similar to other *Geocrinia* creeks. When they returned in spring, the team heard the unmistakable clicking calls of orange-bellied frogs – a discovery that challenged the species' assumed reliance on linear creek systems and led to the discovery of two other new populations in similar small depressions. These were the first new populations found in the 33 years since the species was discovered, and increased the number of natural populations from six to nine, extending the known range of the species by 1.4 kilometres (37 per cent). This is a significant find, considering the orange-bellied frog is one of the most restricted vertebrate species in Australia.

WORKING TOGETHER

Parks and Wildlife Service staff have been working to implement habitat protection measures throughout the frogs' range, including carrying out pig control, fencing, prescribed burning to protect critical habitat, erosion control and closing tracks to reduce the risk of fires escaping from unauthorised campsites.

Since 2008, staff have also been working closely with Perth Zoo Science in Biodiversity and Conservation Science on a backup plan for the frogs, which involves establishing new stable populations in the wild. Each year, staff from Perth Zoo Science collect egg masses from wild populations and raise the young in captivity – a process known as 'head-starting'. In the wild, clutches are prone to predation from invertebrates such as spiders, centipedes, flatworms and freshwater crayfish. And once they metamorphosise, the tiny frogs are vulnerable to desiccation and predation from many other swamp species. It's not surprising then that these youngsters have a very high mortality rate, with only about 20 per cent of eggs surviving to juvenile stage. Over the years, Perth Zoo Science has trialled different husbandry techniques and is now able to successfully raise almost all eggs collected, to release hundreds of tiny one-year-old juveniles back into the wild the following season.

So far, this had led to the release of 1336 juveniles and the establishment of three new white-bellied frog populations and two new orange-bellied frog populations. While the science behind rearing the froglets has been perfected, the real challenge now is to find sites suitable for future releases to help these species to persist in a drying climate.

Above Frogs that have been raised at Perth Zoo are transported to new wild populations.

Right Perth Zoo Science and Parks and Wildlife Service staff transport the frogs to their new home.
Photos – Perth Zoo

Below right A white-bellied frog is given a new chance at life.
Photo – Emily Hoffmann

LOOKING FORWARD

Considering the species are some of the most extensively monitored and managed within the country, it may be surprising that researchers still do not have a good understanding of their habitat requirements. This is because these frogs live on a truly micro-scale. In some sites, the frogs occupy only one to two metres either side of the creek channel and the population ends abruptly, while the suitable habitat (to our human eye at least) appears to continue downstream. Without an effective method for evaluating habitat, finding sites suitable for introducing new populations is very difficult and could lead to releasing the frogs into sub-optimal habitat.

In order to address this management conundrum, DBCA has recently partnered with The University of Western Australia to gather information on the microclimate (such as temperature, moisture, soil type and pH) requirements of the frogs. Emily Hoffmann joined the frogging team in 2017; her PhD research is targeting the knowledge gaps around the factors contributing to recent population declines and aims to better understand the specific habitat and hydrological requirements of these species.

Emily will be using the years of monitoring data gathered by Parks and Wildlife Service staff to investigate how changes in hydrology have impacted population declines. Studying the microclimate and habitat characteristics of sites where frogs occur and have disappeared from, can help us identify crucial habitat conditions for the species' survival.

This information will be critical for identifying suitable release sites that will be able to support large and stable populations. Furthermore, it can be used as a tool to evaluate the viability of populations and management options for these species into the future.

This ongoing work will continue to give these tiny cryptic species a fighting chance, and will hopefully mean their clicking calls will be heard for years to come by the few dedicated staff and researchers who dare to venture into their thick swamp habitats.

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Christine would like to acknowledge the work of DBCA's South West Region nature conservation regional leader Kim Williams. Kim has been leading the monitoring program for more than 20 years and, together with the DBCA 'frogging' team, staff at Perth Zoo and The University of Western Australia researchers has worked tirelessly to conserve these two cryptic species.