



Leap into Hunter Wetlands Centre Australia

to See the Green and Golden Bell Frog Research Project

Doctor Peter Nelson

This time last year, all but one of the Hunter Wetlands Centre Australia's (HWCA) wetlands was bone dry as the drought pounded them into dust. Then, just as the rains arrived; the ponds began to fill, wildlife returned, and everything turned green again, along came COVID-19 and HWCA were forced to close their doors for several months.

HWCA has been restoring and maintaining a forty-five-hectare site on the outskirts of Newcastle, New South Wales for more than thirty-five years. HWCA operate a very successful Visitor Centre and welcomes approximately thirty thousand visitors, including seven hundred members, each year.

Furthermore, over seven thousand school children visit the Wetland Environmental Education Centre facility on site to learn about some of Australia's unique native wildlife.

HWCA started as an effort to restore the degraded wetlands in the region and conserve the large egret rookery on site. Since its inception, the conservation of Australia's threatened and endangered species has always been a core activity of HWCA. As well as restoring habitat on site, and in other areas throughout the Hunter estuary, they have conducted programs and research to assist the conservation of native species including the freckled duck (*Stricktonetta*

naevosa) and magpie goose (*Anseranas semipalmata*), which were once plentiful in the Hunter region, along with many plant species and, of course, frogs.

HWCA have also strengthened their education, research, and conservation ties with their neighbour - the University of Newcastle. Doctor Alex Callen, her colleagues, and students in the Conservation Biology Research Group, on HWCA grounds, on the causes of the dramatic decline in the endangered green and golden bell frog (*Litoria aurea*) due to the deadly chytrid fungus (*Batrachochytrium dendrobatidis*). The University conducted a successful

breeding program at HWCA several years ago, but the research facilities, constructed on site, had been languishing since the program finished. However, the research facilities are now refurbished and are being utilised again.

The green and golden bell frog

Green and golden bell frogs look a lot like other well-known tree frog species, aside from the iconic brassy-golden patterns on their green skin. The variation in pattern is amazing. Some individual frogs can be almost a dark brown, with very little green on them, while others a pale pea-green with light golden patches. Some are almost all green and some individual frogs have a deep olive amongst the

brassy bands. Interestingly, these colours are not fixed. Scientists have observed individual frogs can change colour over the space of a few hours. It is thought that this change in colour is related to inactivity; they seem to become lighter with the more activity they carry out. It is more likely that you have heard a green and golden bell frog than seen one. As in all frogs, it is the male of the species who 'call'. Have you ever heard a motor bike changing gears in slow motion? That is a little like the call of our friend – the green and golden bell frog.

Frogs are amphibians and need wet environments to breed and keep their skin moist, which is essential to their

survival. When they are tadpoles, they can only survive in water. Green and golden bell frogs are a tree frog species, but they spend most of their time a little closer to the ground. They are thought to be largely ground dwelling; in grasses, bushes, and vegetation surrounding still water bodies. However, there are theories that trees may still form an important part of their habitat. It is thought that they need a variety of habitats to survive. Frogs are cold-blooded and mostly nocturnal; this means they need to regulate their own body temperature. Green and golden

Above: The Hunter Wetlands Centre Australia Visitor Centre.

bell frogs are one of the few Australian frogs that can be seen basking in the sun and are active during the day and night.

Population decline

It is hard to believe that green and golden bell frogs were once the most common frog in south eastern Australia. They are now listed as Endangered in New South Wales and classified as Vulnerable on a national scale. They now only exist in a few coastal pockets. Locally, there are substantial populations on Kooragang Island, Terrigal Wetlands, and Sydney Olympic Park amongst others, but they used to be widespread and familiar. There are several factors contributing to their decline:

1. Land clearing and habitat loss – frogs tend to live in freshwater wetland areas which have historically been undervalued and dredged or filled in for development. Urbanisation also fragments frog populations and makes it difficult for frogs to find all the spaces they need for the different parts of their life cycle;
2. Climate change – the changing climate is altering everything, and the wetland areas frogs depend on are most susceptible to drying out;
3. Threats to biodiversity – frogs are a signal of the robustness of an ecosystem;
4. Domestic pets – kill adult frogs;

5. Introduced fish – the mosquito fish (*Gambusia affinis*) was introduced into Australia to help control mosquito populations; it did not work. The mosquito fish do a better job at eating green and golden bell frog eggs and tadpoles and researchers have found that if there are mosquito fish in the area, very soon green and golden bell frogs will disappear from that area; and

6. Infectious diseases – such as chytrid fungus which have decimated frog populations.

The deadly chytrid fungus

Despite frog's skin having amazing antiviral and antibacterial properties, they are still extremely vulnerable to some pathogens such as fungal disease. Chytridiomycosis is a disease caused by the aquatic fungus *Batrachochytrium dendrobatidis* which attacks keratin in the frog's skin and persists in temperate freshwater environments.

Over the last few decades, it is thought to have caused extinction, or severe decline, in more than two hundred species or forty percent of the diversity of amphibians around the world. In Australia, we have already lost at least four species to this disease. Unfortunately, the green and golden bell frog seems to be particularly affected by this pathogen.

All frog species in Australia are affected by chytrid and interestingly, it is not fatal to every species which means it is spread

even more. If there are other frog species in a habitat that are carrying the disease, it is only a matter of time before the green and golden bell frog is exposed. Once the water in a pond is infected it can stay there forever. There is currently no known treatment or control method for this invasive pathogen.

In Australia, scientists are trying to work out why particular species like the green and golden bell frog and the two species of corroboree frogs seem to be so badly affected, while other species are not affected. Research is being conducted in the sites green and golden bell frogs occupy and are thriving, and why some areas seem to offer sanctuary. Interestingly, some of these locations are places that would be thought of as toxic or inhospitable such as Sydney Olympic park and Ash Island in the Hunter River estuary. The speculation is that these environments may be inhospitable to the fungus so frog populations can persist here, even though the habitat is not ideal. More research needs to be conducted and HWCA are proud to be playing a role in these investigations.

HWCA are working closely with the Conservation Biology Research Group at the University of Newcastle to answer some questions about why frogs are disappearing and what can be done about it. HWCA have dedicated funds to refurbish the isolation ponds on their property, to research the relationship between habitat and the prevalence of disease, chytrid fungus, in green and golden bell frog populations.

The sign is a comprehensive educational resource. It starts with a title 'green & golden bell frogs (Litoria aurea)'. The first section, 'WHAT'S A GREEN & GOLDEN BELL FROG ANYWAY?', describes the frog's appearance, habitat, and life cycle. The second section, 'WHAT'S HAPPENED TO THE GGBF POPULATION?', discusses threats like land clearing and chytrid fungus. The third section, 'RESEARCH HERE AT HUNTER WETLANDS CENTRE', highlights local conservation efforts. The fourth section, 'WHAT ARE HERPETOLOGISTS & CONSERVATION SCIENTISTS?', explains the role of researchers. The fifth section, 'WHAT CAN I DO TO HELP?', provides practical advice for the public. The sixth section, 'WHAT CAN I DO?', lists specific actions like reporting sightings and participating in citizen science. The seventh section, 'AMAZING FROG FACTS!', shares interesting trivia. The final section, 'WITH SPECIAL THANKS', acknowledges partners like the Australian Wildlife Society.

The new green and golden bell frog educational sign, kindly donated by Australian Wildlife Society.

Research program

Scientists are conducting research at HWCA by closely monitoring and studying different aspects of the populations that survive. They use these observations to develop propositions. They then create experiments to test these propositions in controlled environments. Doctor Callan and her team want to answer the following primary questions:

1. Can elements of wetland habitats influence the prevalence of disease in frog populations? In other words, are there things about the frogs habitat which make it more or less likely for diseases like the chytrid fungus to infect the frogs which live there; and
2. Could trees help? The researchers have created a specific environment in which to investigate this question. Just across the canoe channel, six ponds have been created, three with trees around them and three without. These ponds are separated by frog-proof fences.

Green and golden bell frog tadpoles, from the captive breeding program at the University of Newcastle, were evenly distributed among the ponds in late 2020. The researchers will conduct regular surveys and closely monitor the health of the populations in each of these ponds, collecting and analysing data to try and find the answers to these questions. We hope this research will lead to important advances in understanding innovative solutions to help sustainably manage these ecosystems, and make sure the green and golden bell frog can survive and thrive within a healthy ecosystem.

HWCA and the University of Newcastle have successfully reintroduced green and golden bell frog populations back to the wild in the past. The current study looks at trees and how the frogs use them in the wetland. Will the use of trees affect the presence of the fungus in the frogs? The answer to this question is yet to be determined. The researchers are also investigating the thermal properties of different microhabitats and whether they are used differently by frogs with a different infection status.

The premise is that frogs use trees, if they are available, and can spend less time in contact with a pond or moist soil, where they would be exposed to the pathogen. If the premise is correct, and the presence of trees and their use by frogs results in less fungus infections, then incorporating trees into man-made and rejuvenated wetland environments, could be an important means to help the green and golden bell frogs survive.

Through the support of the Australian Wildlife Society, Hunter Wetlands Centre Australia was able to install a new educational sign adjacent to the green and golden bell frog research area. The sign details the work being implemented to help conserve the green and golden bell frog and encourages visitors to take action to help protect this precious species.

For further information about Hunter Wetlands Centre Australia, and the research being conducted at their site, please visit their website www.wetlands.org.au



The green and golden bell frog (*Litoria aurea*).



Aerial view of the research frog ponds.



Hunter Wetlands Centre Australia volunteers repairing the frog-proof fences at the research ponds.