FROGCALL

No. 176, December 2021

THE FROG AND TADPOLE STUDY GROUP NSW Inc.
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MEETING FORMAT

Friday 3rd December 2021

NB: Due to Covid requirements, the Education Centre can no longer hold more than 25 people. Please email Arthur White (1arthur@tpg.com.au) to obtain confirmation of your attendance, including the number of people with you.

6.30 pm: Lost frogs: Priority to new pet frog owners. Please bring your membership card and cash $50 donation. Sorry, we don't have EFTPOS. Your current NSW NPWS amphibian licence must be sighted on the night. Rescued and adopted frogs can never be released.

7.00 pm: Welcome and announcements.

7.45 pm: The main speaker is to be announced.

8.45 pm: Frog-O-Graphic Competition Prizes Awarded.

9 pm: Trivia Quiz, raffle, Christmas supper and a chance to relax and chat with frog experts.

Thanks to all speakers for an enjoyable year of meetings (both via Zoom and face to face), and all entrants in the Frog-O-Graphic Competition. Let's hope for face to face meetings in 2022!

Email **monicawangmann@gmail.com** to send an article for FrogCall.

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Cover photo: Northern Spadefoot, *Notaden melanoscaphus* calling (Kununurra, WA) **Marion Anstis**

President's Page

Arthur White

2020–2021 has been another difficult year for FATS (and everyone else). COVID-19 lockdowns and restrictions on gatherings forced us to cancel many of our public events. Our AGM could not be conducted face to face and so we resorted to a remote conference format.

This year we were able to hold a few field trips earlier in the year, but it has stopped again because of the latest outbreak of COVID in NSW. Frog rescues have had to be stopped at times. At present, east coast Australia has experienced a major Chytrid outbreak amongst frogs. We have had to modify our advice to people who find sick frogs, so that they don't breach health restrictions.

The one activity that has continued relatively unaffected has been the production of FrogCall and even this has taken place under unusual conditions. Monica, our editor, is still confined to Victoria and has produced the last editions of FrogCall from that state. She has managed to get FrogCall out on time and this remains our best contact with members at present. Monica and Marion, once again, have produced our annual, printed colour edition of FrogCall for December, 2021.

Despite the chaos, FATS has retained a loyal following and our membership remains steady. COVID restrictions will be in place for some time yet and planning of future events remains uncertain. We will continue to inform members of any changes or any new activities that we are able to host in the future.

FATS remains financially strong, thanks to our long-standing Treasurer Karen White. We have offered and awarded two student research grants this year.

FATS completed the annual Bell frog auditory surveys at Sydney Olympic Park in November and December 2020. Thanks to SOPA for supporting FATS and thanks to the members who came and helped on the night surveys.

Robert Wall organised a great series of field trips but many of these had to be cancelled at short notice because of COVID restrictions. He has planned a full programme for the upcoming spring and summer but again we cannot guarantee that they will all run.

Kathy and David Potter organise our events programme and they have had to cancel many events at the last minute. The current COVID outbreak has thwarted all of the planned events for the next two months.

Punia Jeffery and Marion Anstis shared the role of meeting spokesperson and both help out with various other activities of Council. Phillip Grimm has two roles, membership officer and webmaster and does both with great efficiency.

Our thanks to Jilli Streit who has been our secretary and has done a good job in that role.
Many thanks to our other executive member: Andre Rank. Each has contributed whole-heartedly and helped keep FATS alive and well.

Finally, I would like to thank all of our members for being so loyal and patient during these trying times and for making FATS such a great group to be in. Hopefully 2021–2022 will be an easier year.

Can bugs do it better? Early success and future research using DNA from parasites to find frogs

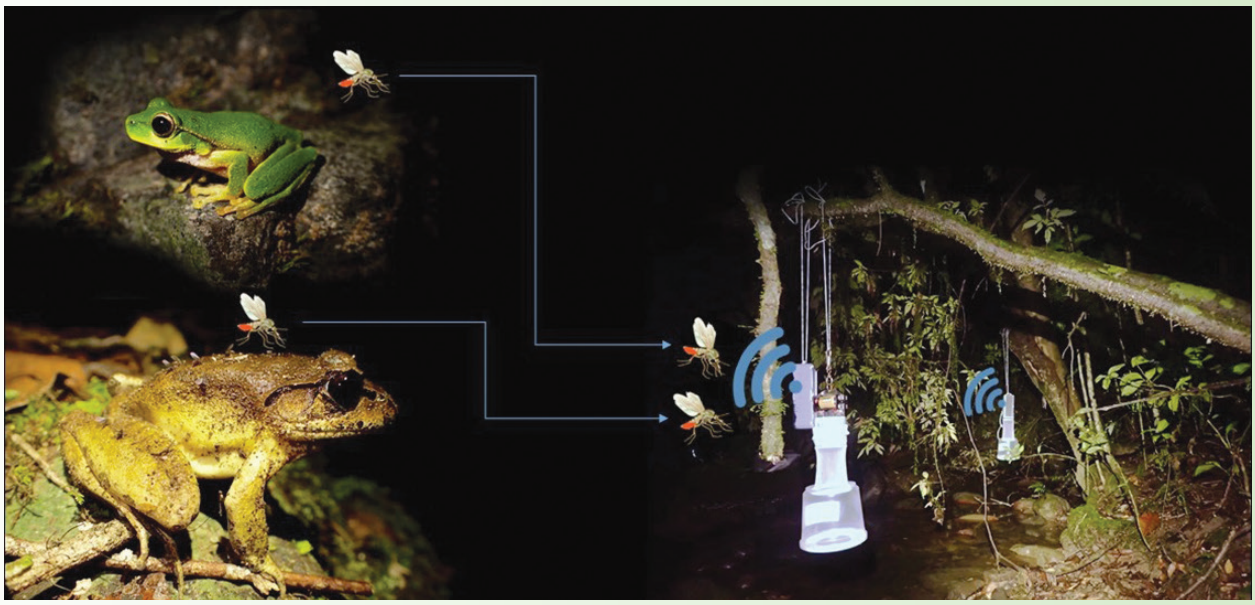
Tim Cutajar

Litoria rheocola with a *Sycorax* fly feeding on its nose; Daintree NP **Jakub Hodáň**

Late one night in spring 2016, wading knee deep in a cool, clear mountain stream, I saw something in the light of my headlamp that would shape my scientific path indefinitely. I was on the first of many Australian Museum expeditions to the New England Tablelands of New South Wales, searching with my boss and now PhD supervisor Jodi Rowley for the Peppered Tree Frog (*Litoria piperata*), last seen alive in 1974. On one of our surveys, Jodi pointed out some tiny flies sitting on a frog's back, sucking its blood – frog-biting flies. I'd never heard of them, so when Jodi explained that they feed only on frog blood, and find frogs by following the sound of their calls, I was amazed! The search for the peppered tree frog went on for years, with no success. But the sight of those flies, with their abdomens engorged and bright red with blood, was seared in my memory.

Why put so much effort into finding the peppered tree frog, or any species? In a changing world, the challenge of conserving biodiversity is becoming increasingly urgent. However, before we can effectively conserve species, we need to know where they are and how they're doing.

Unfortunately, many frog species are so hard to find that traditional survey techniques often fall short of detecting them. There are many



Composite image showing **Method** used for capturing frog-biting flies with playback frog calls and suspended traps
Tim Cutajar

new species detection methods out there, some of which can help detect some frogs. Environmental DNA (eDNA) is a good example – trace DNA can be filtered out of natural waterways and barcoded to detect local frogs. However, this method works best with very aquatic species, potentially leaving more terrestrial frogs high and dry.

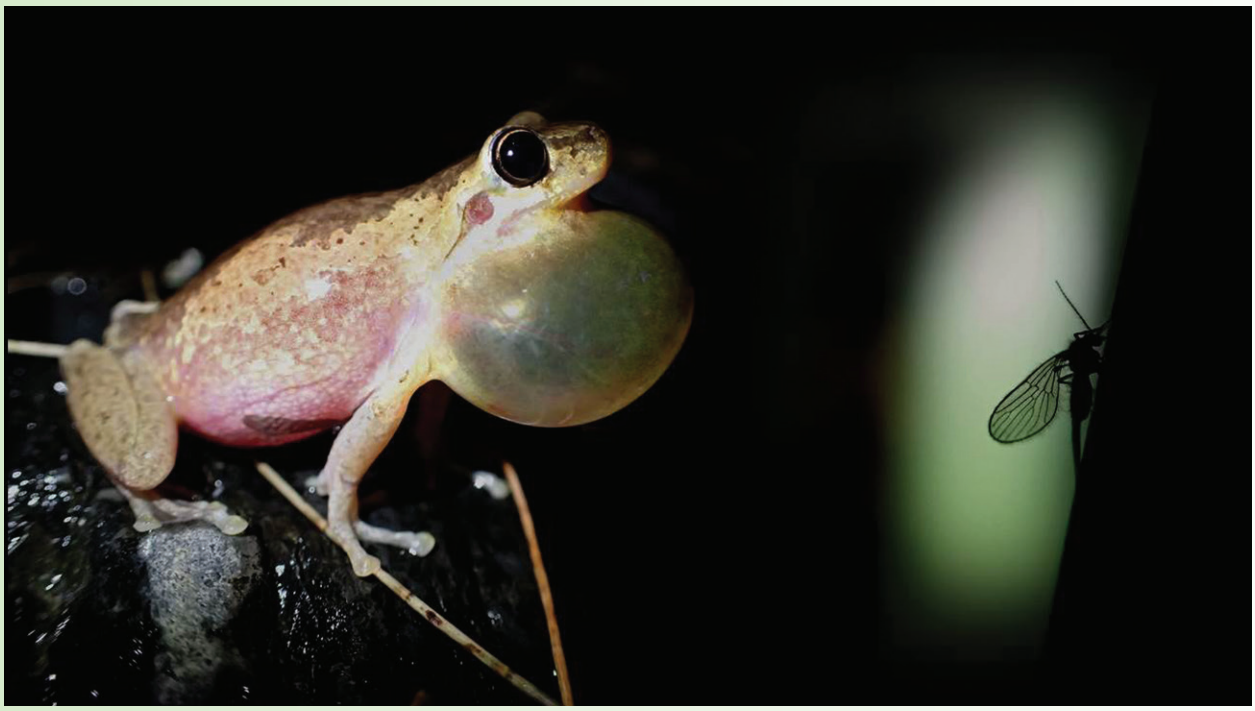
Invertebrate-derived DNA (iDNA) has emerged in the last decade as an innovative new tool for detecting rare and elusive terrestrial vertebrates. Like eDNA, iDNA uses DNA barcoding, but it's less like randomly dipping a net, hoping to catch a fish, and more like directly calling a fishmonger. In iDNA surveys, researchers can put out rotting meat to attract blowflies, carbon dioxide for mosquitos, or even offer themselves as bait to catch leeches. These invertebrates have been out in the landscape searching for animals, and some will have found them, fed, and have that animal's DNA conveniently packaged in their belly and 'freighted' directly to a trap for sampling!

Mulling over our failure to find the peppered tree frog about a year into our search, and thinking there must be another way, those flying packages of frog DNA came to mind and I broke the silence in our office: "I have a kind of crazy idea". I hadn't heard of iDNA at the time, so I really meant it when I said crazy, but it seemed worth a try.

So, in November 2018, armed with mosquito traps and MP3 players broadcasting frog calls as 'bait' to attract the flies, we set out to the beautiful forests of Barrington Tops, NSW, for a short expedition to test the idea of using DNA from the bellies of frog-biting flies as a frog survey technique. We were in Barrington Tops for a week, attempting to detect frogs at a different site each night. We would arrive at a site in the late afternoon and find a suitable tree from which to hang our traps, then adjust the MP3 players so they were right next to the trap's intake, but we wouldn't turn them on just yet.

If the method was going to work at all, we wanted to get an idea of how it compared to the more traditional active frog searches we were used to. To test that, after sundown, we spent an hour and a half searching for frogs along a 100 m section of stream, starting where the traps were hung, and recording every frog seen or heard. We saw some fantastic frogs, from the tiny Barrington Tops Tree Frog (*Litoria barringtonensis*) to the beautiful Red-eyed Tree Frog (*L. chloris*), the large, threatened Stuttering Frog (*Mixophyes balbus*), and others.

Each night, seeing all these frogs, I would wonder if iDNA would tell a similar story about the local frog diversity. At the end of our traditional searches, we would switch the traps and speakers on, hoping to find some flies caught



Bleating Tree Frog, *Litoria dentata* calling, with a *Sycorax* fly perched in waiting! **Tim Cutajar**

next day, and we'd head back to our accommodation.

The morning after the first survey night, we got up at sunrise, partly because we were anxious to see if we'd caught any midges, and partly because if we had, we didn't want them spending too long digesting any frog blood they might have eaten, thus degrading the DNA.

We pulled up at the site and made a beeline through the forest to our traps, which were easy to find because they were still playing frog calls. Reaching the traps, I peered inside, and yes – it was full of *Sycorax* flies, known frog biters! Over the week we continued to trap large numbers of *Sycorax* and *Corethrella*, another frog specialist. Things were looking good for our project, but of course we wouldn't know whether we had collected any frog DNA until we got back to the lab.

Once back at the museum, I couldn't wait to start working on our samples. I brought them into the lab and began the process of extracting and sequencing DNA from the flies' bellies. The last step in that process had to be done by another lab, so I sent the samples off and waited. I had a camping trip coming up, but anticipated receiving results soon, so I took my computer with me. Each morning on my trip, the first thing I did was check my email for the results. The morning they came, I couldn't believe it; five of our flies had been carrying the DNA of Davies' Tree Frog, a beautiful, threatened species that we hadn't seen or heard at all during the fieldwork. Not only that, but through iDNA we'd detected species that we didn't detect during traditional surveys at more than half of our study sites!

Trap full of *Sycorax* flies **Tim Cutajar**

Green Tree Frog, *Litoria caerulea* with many mosquitos enjoying a feed! **Lachlan Pettit**

Establishing iDNA with frog-biting flies as a frog survey method is just the beginning. Our small pilot study raised even more questions than it answered: *Just how effective is iDNA for detecting frogs versus other methods*? *Does its effectiveness vary across species, habitats, or even continents*? *What makes a frog species a good or bad candidate for iDNA surveys*? *And how can frog detection success through iDNA be maximized*?

To find out, I am devoting a PhD to the topic. In a collaboration between UNSW Sydney, the Australian Museum, and the University of Copenhagen, I will spend the next three years or so trying to understand the relationship between frogs and their parasites, using what I find out to build on the technique, and ultimately put it into practice.

Though extremely new as a survey method, I'm very excited about the future of finding frogs through iDNA. It's my hope that iDNA will prove a useful tool in detecting frogs of diverse species and across many places and habitats, contributing those invaluable species records that help us understand where species live and what their conservation needs are. There's plenty of work to do over the next few years. Hopefully that work will result in some interesting discoveries, so watch this space. Who knows, we may find that peppered tree frog yet!

More information:

Cutajar, T.P. and Rowley, J.J.L. (2020) Surveying frogs from the bellies of their parasites: invertebrate-derived DNA as a novel survey method for frogs. *Global Ecology & Conservation*. e00978.

Acknowledgements

I am grateful to Brittany Mitchell for help with fieldwork, Cameron Webb for the loan of mosquito traps, and my supervisors Jodi Rowley, Kristine Bohmann and Alistair Poore for their ongoing support. The fieldwork in Barrington Tops was generously supported by the Frog and Tadpole Study Group of New South Wales.

Wetland Restoration for the Green and Golden Bell Frog (*Litoria aurea*)

Chad Beranek

Pair of Green and Golden Bell Frogs (*Litoria aurea*) in amplexus on Kooragang Island **Chad Beranek**

Building frog ponds has been a hobby of mine since I was seven years old when my dad installed our first frog pond in the garden. I was always so curious about what factors influenced whether you would get certain species showing up and calling there. This hobby has turned into a passion and now I am actively involved in restoration and habitat creation projects for wildlife. This is why I was incredibly excited when I got a PhD offer for a project that was focused on the curious hobby of my seven-year-old self.

I started my PhD at Newcastle University by investigating the restoration ecology of the Green and Golden Bell Frog (*Litoria aurea*) at the end of 2016, with supervisors Prof. Michael Mahony and Dr. John Clulow. The goal was to investigate the response of a Bell Frog population to wetlands that were constructed to passively manage Mosquito Fish (*Gambusia holbrooki*) and chytrid-induced disease. The field site for this study was situated on **Kooragang Island** (32° 50–54°S, 151° 42–47° E), located at the mouth of the Hunter River in NSW, Australia (see Fig. 1). The island is ~30 km² in surface area and contains numerous wetlands including man-made and natural water-bodies.

It has been shown previously that a level of increased salinity in breeding ponds reduces chytrid infections in this species, and can even eliminate it periodically in ephemeral wetlands.

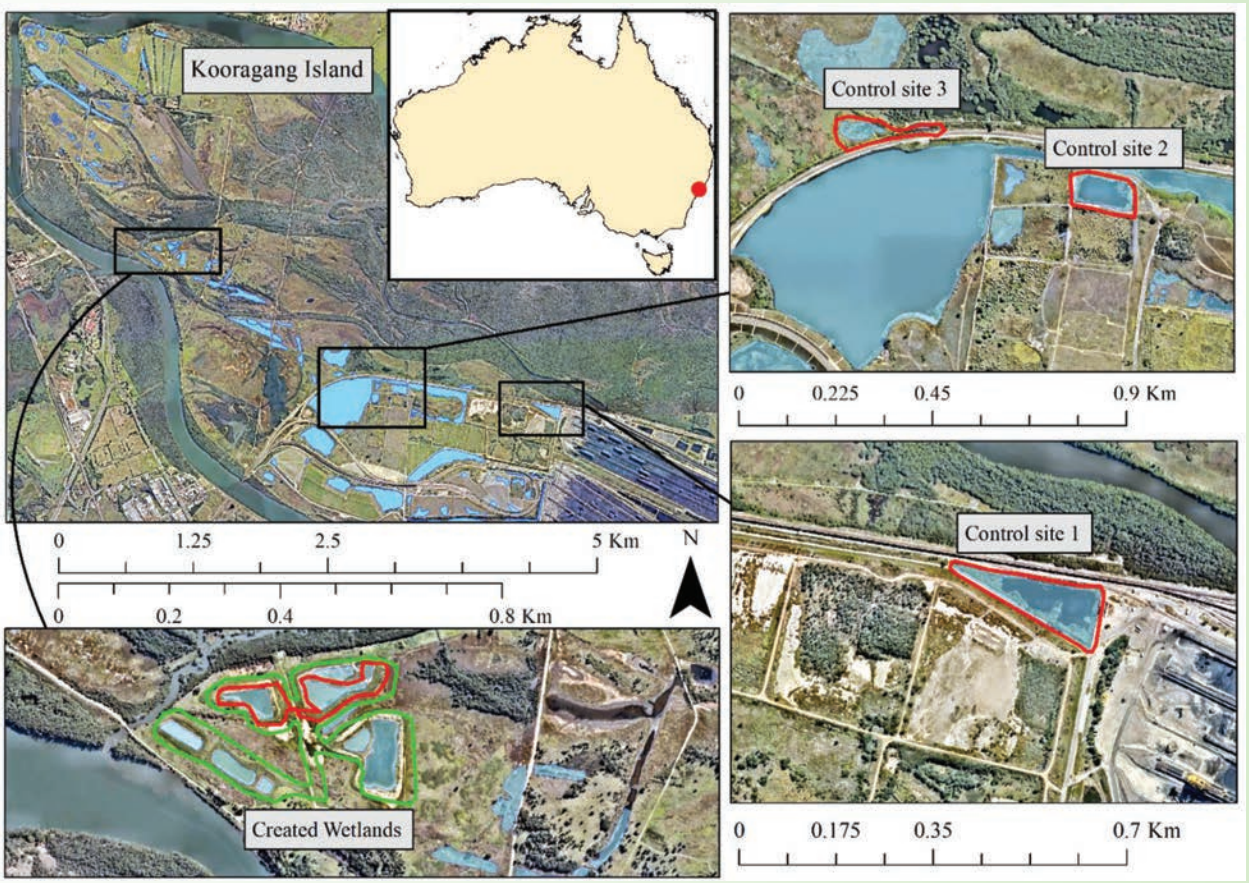


Fig. 1. Map of study sites. Blue objects indicate wetlands surveyed for *L. aurea*. Green outline indicates the survey area in the created wetlands. Red indicates the survey area of the control sites and the reduced survey area of the created wetlands. High resolution aerial imagery obtained from Nearmap (2020), image date: May 04, 2016.

We created nine wetlands (two permanent, three semi-permanent and four with short hydro-periods), with specific features designed to increase breeding, recruitment and survival of *L. aurea*.

With this knowledge in mind, the created wetlands were constructed near a natural wetland that has supported a small existing *L. aurea* population, and were hydrologically designed to either:

(1) have a short hydroperiod, or

(2) have a permanent hydroperiod

In both situations the aim was to retain salinity values within a range of greater than 2 parts per thousand (ppt) to less than 9 ppt (which is the upper threshold tadpoles of *L. aurea* can tolerate). This would then create an artificial saline refuge from chytrid.

The presence of the introduced Plague Minnow Fish *Gambusia* was also mitigated by creating ~0.6–1.4 m high earthen bund walls (clay embankments) around the perimeter of the wetlands to prevent overland flow of water which would replenish *Gambusia* colonisation. Further details about this research can be found in the first chapter of my PhD, published in 2020 (see *Reference no. 1*).

I had to begin fieldwork quickly, as I started in September, which is when the Bell Frogs usually start. There was no time to think carefully about experimental design and questions to ask, I had to dive right in knowing that the questions and experimental design would all include some core data: capture-mark-recapture, frog details (size, sex, weight etc.), tadpole netting, chytrid prevalence, water quality and hydroperiod. I stuck with these parameters and got into the field ASAP.

I also had no idea how regularly to sample. Since the first few weekly surveys only resulted in capturing 20 – 40 frogs each night, I decided weekly surveys needed to be continued for the entire breeding season. My other logic for this decision was that many expert ecologists have researched this species before, and I felt the only way to gain any extra insight into this frog was to try and spend as much time in the

field with the frogs as possible, which I hoped would lead to new insights. The first year was quite cruisy, I had many excellent volunteers and field work was fun and usually one round of sampling took 1–2 nights.

During the first season, we obtained pre-emptively what I was calling "the royal flush"; observations of males, females, tadpoles, metamorphs, eggs and juveniles. It was amazing how quickly the frogs colonised the new wetlands and how quickly the wetlands became productive breeding sites. I recorded 10 breeding events during the first year. By the time I got to the second year, the population had exploded. What used to take me 1–2 nights, now took me 4–5 nights of surveying. Only sheer stubbornness allowed me to continue weekly surveys.

One fascinating trend that emerged as I collected data from the second year, was that while there were many more adult males compared to season 1, the number of adult females we caught was very similar to the previous year. This led me to investigate growth patterns and how long it took frogs to reach maturity. Since I had an immense data set from the continual weekly surveys, I was able to use this data to determine what age females and males matured at. Sure enough, the females took much longer than males to mature. It dawned on me that this factor was an important regulator of population dynamics in Bell Frogs (and probably many other frogs), and is especially important for reintroductions. If you only release one load of tadpoles, the next season you will have only adult males and no adult females to breed with the males. Since Bell Frog survival is so low, you would need a lot of tadpoles to produce males and females that survive to their second year. These ideas resulted in another one of my PhD chapters (*Reference 2*).

After the chaos of the second year of surveys, I resolved to prepare for even larger possible increases in population size, because once again, I recorded 10 breeding events (remember that each breeding event likely consists of multiple mating pairs, and each female can produce 5000 or more eggs in a clutch). I led an army of volunteers into the wetlands for my third season. Their sacrifices of sleep on the Bell Frog battlefield was due to my determination to keep up the weekly survey effort. As I anticipated, the Bell Frog numbers had increased by another order of magnitude. They were by far the most common frog on the site, and it was exciting to be immersed in Bell Frog choruses of 30–50 males after rainfall events. Sure enough, when I did the population modelling, the adult population size estimate for the first year was ~150, the second year was ~700 and the third year was ~1200!

But why did they go so well in this habitat? *Did our plans of passively mitigating chytrid and Mosquito Fish work*? This was the subject of another one of my chapters in which we looked at the chytrid prevalence data and the spread of Mosquito Fish from the study site to nearby control sites. We found that the Mosquito Fish were contained well with the bunding walls (bar a few incursions which were likely due to improper draining of the wetland basin in permanent wetlands before they were refilled). However, chytrid prevalence on the site was quite high and survival was quite low. It appears that these wetlands were offsetting chytrid impact by excluding Mosquito Fish (which deter frogs from breeding in ponds), thereby maximising frog breeding and recruitment.

The salinity and the ephemeral ponds did not entirely mitigate the threat of chytrid. Although there were some interesting observations that can help inform future designs, I found that chytrid prevalence in non-saline wetlands was lower if there were highly saline wetlands nearby. Indeed sometimes I saw frogs 'having a bath' in the highly saline wetlands usually after rain. In future designs for chytrid-impacted amphibians, one could envisage a checkerboard mosaic of freshwater wetlands interspersed with highly saline wetlands. The details of this chapter are presented in *Reference 3*.

The most amazing moments being in the field doing this research usually came around late February each year. This is when my supervisor Mike Mahony would always hammer into me, "be ready for the late summer rain, this is where you get the most data!". During these periods, I endeavoured to be out in the wetlands as the rain came and repeatedly visit the site every night to collect data. It was amazing to hear the choruses, not just of Bell Frogs, but Bleating Tree Frogs, Eastern Sedge Frogs, Common Eastern Froglets, Striped Marsh Frogs, Spotted Marsh Frogs, and the odd Green Tree Frog (this one was never on

Chad Beranek in wetland on Kooragang Island, monitoring Fyke nets and funnel traps for tadpoles **Ray Marten**

my site unfortunately but they persist in low numbers on Kooragang Island). While these were amazing, what came after was even more amazing and led to insights for another PhD chapter…

About one month after these late breeding events, we would set out Fyke nets (0.7 m × 5.7 m, 4 mm mesh) monthly in each of the nine wetlands from September–March each year to capture Bell Frog tadpoles. The nets were placed with the mouth open towards emergent or submerged vegetation to optimise capture of *Gambusia* and/or *L. aurea* tadpoles, as both use this microhabitat more frequently than open water. This time of year always produced the most Bell Frog tadpoles despite putting the Fyke nets in the same spots in the wetlands at other times of year. My record for the most Bell Frog tadpoles captured in one net was ~950 and this was after breeding events associated with heavy summer rain. What followed after this was hundreds, if not, thousands of metamorphosed Bell Frogs. The Bell Frogs still bred during spring and the start of summer, usually in the permanent wetlands at that time of year, but during these times I never caught so many tadpoles or observed so many metamorphs. *What was producing these obvious discrepancies*?

While conducting monthly Fyke net surveys, I was recording every other species I caught in the nets (if it was easily identifiable). This included the Hunter Endemic Yabby (*Cherax setosus*), the Giant Water Beetles (*Cybister tripunctatus* and *Hydrophilus pedipalpus*) and also the larvae of the Australian Emperor Dragonfly (*Anax papuensis*). Now is probably a good time to mention that I also opted to do weekly monitoring of wetland birds on the site and reptiles with artificial refuge surveys (a fancy way of saying "I lifted tin sheets to look for reptiles warming themselves"). I also recorded every animal we encountered during routine visual encounter surveys of the frogs. This extra data meant that I could test several hypotheses concerning what was driving the numbers of metamorphs I was seeing, while considering the following criteria:

1) density of tadpole predators

2) water temperature

3) salinity

4) detection probability (I ran an experiment to see if it was easier to find frogs in different wetlands)

5) more breeding in later summer due to more mating pairs (I tested this with genetics)

It turned out that the most correlated factors were predators on tadpoles, and I found that such predators were in significantly lower densities in the newly replenished freshwater wetlands. This just goes to show the importance of having a mosaic of habitats for amphibians on Kooragang Island. Essentially, the ephemeral wetlands provide enhanced recruitment for Bell Frog populations and the permanent wetlands are important as a drought refuge. The details of this chapter are shown in *Reference 4*, which will be published in Wildlife Research at the end of 2021.

Some other amazing experiences I had in the wetlands were not with Bell Frogs, but with other species that shared the ecosystem. There was a regular occurrence in the wetlands of the Large-footed Myotis (*Myotis macropus*), which is a specialised microbat that uses its feet to capture aquatic prey. This bat is also threatened in NSW so it was a great treat to have them using the site. Some nights I would be walking through a wetland with the team and we would be surrounded by 5–10 *Myotis* which flew around us in figure eights, capturing prey, usually moths (but I also saw one take a water spider *Dolomedes facetus*). I got a few close up views of one trawling through the water for prey. This led me to another opportunistic chapter, which I did with a research undergraduate student Giorginna Xu. We documented this co-occurrence of a threatened bat and a threatened frog to demonstrate that constructed wetlands can be designed to benefit multiple threatened species simultaneously (*Reference 5*).

It was not only threatened microbats that used the wetlands… I also made several sightings of eastern grass owls (T*yto longimembris*) which appeared associated with a large number of house mice (*Reference 6*) that grew in number in response to the flowering of the wetland Bulrush plant *Typha orientalis*. I also came face-to-face with rare wetland birds (literally face-to-face), including a stunning male Painted Snipe and a female Australian Little Bittern, both rare sightings in the Hunter. In fact the Little Bittern sighting was one of only about 10 reported in the region. These observations caused a stir in the bird world, and I had Hunter birders flocking to my site in hopes of seeing these rare species to add to their Hunter 'lifer' list. I made the most of

Encounter with a rarely seen Painted Snipe **Chad Beranek**

the opportunity and bargained the promise of them helping me with field work and in return I would show them the rare birds. Unfortunately not many got to see them. Only myself and a handful of volunteers got to see the Little Bittern (although we made another sighting of a male a year after the first). Other birders were luckier with the snipe since it stuck around for three weeks or so. While these observations were not of immediate importance to my PhD thesis, they were documented in scientific publications (*References 7–8*):

In Conclusion

Now that I'm at the end of my PhD, I highly regard the value of those additional observations of other wildlife and I am glad I stubbornly attempted to survey everything weekly in the wetlands over the last few years. The wetlands were built on a cow paddock and now several years on, they are highly abundant and rich in species, and provide resources for many threatened wetland animals. I think there is an argument to be made that Bell Frogs may be an important umbrella species for wetlands, much the same as how the koala is for the forests.

If we make habitat specific to Bell Frogs (which involves mosaics), then we benefit a large number of other species. Maybe even the bitterns have declined due to the decline of the Bell Frog since they are a relatively large and easy to obtain prey item? (I know from experience that capturing a striped marsh frog is much more difficult in a large wetland compared to capturing a Bell Frog).

One of my goals as an ecologist going into the future beyond my PhD is to restore Bell Frog populations in areas where they have gone locally extinct, with a mixture of reintroduction and habitat creation. My PhD experience has lead me to important insights on how to conduct these more effectively. It is my hope that by re-establishing this species across its range, it will lead to an overall increase in wetland species diversity and stave off extinction for many other threatened species.

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Frogs and Fried Fish! The Surprising Impacts of the 2019-2020 Bushfires

Samantha Wallace & Sarah Stock
University of Newcastle, NSW

Stream study site and habitat for the Southern Heath Frog, *Litoria watsoni,* Parma Creek Nature Reserve, Jervis Bay NSW, following the devastating bushfires of 2019–2020. **Samantha Wallace**

If you ask any conservation researcher working on animals (or even plants and fungi), they'll undoubtedly agree that you develop a strong affection for whichever species you dedicate a considerable amount of time, sanity, and manual labour studying. The same connection one feels with a beloved pet, we feel for the species we're working on. It's not always rational and can sometimes be a rather depressing field – particularly in the case of working with highly threatened species. It's this love for our work and study species that drives our passion for conservation.

Since the spring of 2018, I have been on board with the University of Newcastle team – including Sarah Stock, Lucy Gill, Kaya Klop-Toker, Matt Hayward and Prof. Michael Mahony – researching the cryptic Littlejohn's Tree Frog. This frog has now been recognised as two separate species thanks to genetic evidence recently uncovered by Michael Mahony and his fellow researchers. So, one frog species became two: the Northern Heath Frog or Littlejohn's Tree Frog, *Litoria littlejohni*, and the Southern Heath Frog, *Litoria watsoni*.

Northern and Southern Heath frogs are fairly large, typically brown in colour, and sport a winning combination of characteristic orange thighs and a curry-like/maple-syrupy aroma (their scent tends to vary depending on who you ask!). Quite the unique frogs!

My colleague Sarah and I research the genetic structure and habitat ecology of these frog

species and investigate the causes of their apparent decline. With study sites located from the Watagan National Park, near Newcastle, to Jervis Bay in southern New South Wales, we have scampered after these frogs every summer, autumn, winter, and spring for the past three years. Bonding over frog antics, inclement weather, and the frustrations of surveying for a species that doesn't often want to be found, Sarah and I developed a keen interest in the frogs and became invested in their conservation.

Enter the Black Summer bushfires of 2019–2020. Sarah and I could only watch on with the rest of Australia and the world as a swathe of habitats along Australia's southern and eastern coasts burned at an unprecedented scale, and with a terrifying intensity.

Gearing up for Christmas in my Melbourne family home, Sarah messaged me from Newcastle with the grim news that the bushfires had spread to our study sites near Jervis Bay. Multiple fires merged to race across the landscape. How was the Southern Heath Frog – a species already suffering marked declines – and the other plants and animals in the area to cope with such an immense and severe bushfire event? The frog's prospects appeared bleak.

We were unable to access the bushfire-affected region until the July of 2020 – some five months after the bushfire occurred. Months of waiting and wondering how the frogs and the surrounding habitat had fared in the aftermath of the fires ensued. Finally, we gained permission to conduct our surveys.

Expectations were mixed as we drove through Jervis Bay and onto our field sites. The scene we were greeted with upon arrival was not very inspiring: full canopy scorch in most areas, no understorey vegetation, and heavy ash deposition in the formerly crystal-clear streams. Most trees didn't have a single leaf to them. Seeing the scale and intensity of the bushfire's destruction, we quickly despaired of the Southern Heath Frog's fate. Even after extensive searching, we could only find four tadpoles across all our study sites.

Stream study site and habitat for *Litoria watsoni,* Parma Creek NR, some regrowth after the fires **Samantha Wallace**

Habitat for *Litoria watsoni,* Parma Creek NR, Jervis Bay NSW, showing post-fire regrowth **Samantha Wallace**

Distracted by the ash and the blackened trees, we made our way to the final site. No Southern heath frog tadpoles could be found amongst the sandstone pools – but they weren't the only thing missing… This stream and another nearby had previously been plagued by thousands of introduced Mosquito Fish (*Gambusia holbrooki*). These small introduced fish are voracious predators of frog tadpoles and eggs, and will actively spread into new areas following flood events. Astonishingly, the *Gambusia* were nowhere to be seen – we couldn't find a single fish amongst the pools! *Had the fish been swiftly fried by the intense heat of the bushfires*? *Had they been wiped out by the degraded water quality caused by the ash*? We couldn't be sure what caused it, but one thing was clear – the *Gambusia* were gone!

When darkness descended, we were greeted to the enthusiastic calls of several different stream-breeding frogs. Frog species we hadn't seen at the site before were now happily calling from this intensely burnt habitat – and it seems that the fire did them somewhat of a tiny favour, albeit in a roundabout way. In ridding the stream of *Gambusia*, the bushfire allowed several species of frogs to colonise the stream for breeding. Haswell's Froglet (*Paracrinia haswelli*), Blue Mountains Tree Frogs (*Litoria citropa*), Stony Creek Frogs (*Litoria lesueuri*), Peron's Tree Frogs (*Litoria peronii*), and Tyler's Tree Frogs (*Litoria tyleri*) could be heard singing from the rocks, pools and crevices of the sandstone stream. Free from the predation of *Gambusia*, the frogs made their return.

To top the night off, we heard the familiar 'reet' of the Southern Heath Frog echoing from a nearby study site. With silly grins plastered on our faces, we rushed to investigate. Four sets of shining eyeballs greeted the light of our headtorches. While the heath frogs were present at low densities, they were hanging on! This was all the encouragement we needed. The Southern Heath Frogs were determined to stick it out – and so were we.

We have visited the fire-affected sites four times following the bushfires, and the *Gambusia* have not returned to the creeks. Stream-breeding frogs like the Blue Mountains Tree Frog seem to be bouncing back well after their fires. The grumbles of many calling individuals can be

Large female *Litoria watsoni,* sitting on a burnt log near the stream, Yadboro State Forest, NSW **Samantha Wallace**

heard along the sandstone creeks in the warmer months.

Unfortunately, although the Southern Heath Frog still persists, they seem to be in much lower numbers following the bushfires. However, the heath frogs haven't given up the struggle just yet! New conservation programs for the charismatic species (and its sister species, the Northern Heath Frog) are on the cards. Fresh researchers have joined team Heath Frog, and awareness of these amazing frogs is growing apace.

We hope that, given enough time and a bit of help from us, the heath frogs will recover alongside the regenerating landscape. Who knows, they might even move into the now *Gambusia*-free streams – prime real-estate in the frog world!

Male Northern Heath Frog, *Litoria littlejohni* in a stream pool in the Cordeaux Catchment, NSW **Samantha Wallace**

Blue Mountains Tree Frogs
Litoria citropa
© Josie Stokes

FATS Frog-O-Graphic

BEST IMAGE: Above: Crucifix Frog, *Notaden bennetti* **Josie Stokes**

BEST IMAGE: Below: Cooloola Sedge Frog, *Litoria cooloolensis* **Damian White**

Competition WINNERS

MOST INTERESTING IMAGE: Above: Ornate Nursery Frog about to hatch, *Cophixalus ornatus* **Marion Anstis**

MOST INTERESTING IMAGE: Below: Tusked Frog pair laying eggs, *Adelotus brevis* **John Pumpurs**

Frog-O-Graphic Winners

MOST INTERESTING IMAGE: Main's Frog, *Cyclorana maini* emerging after rain **Katie Pasfield**

BEST PET IMAGE: Baby Green and Golden Bell Frogs, *Litoria aurea* **Charles Timm**

...and some other selections from this year's excellent entries

PEOPLE'S CHOICE: Above: Green-thighed Frog, *Litoria brevipalmata* **Narelle Power**

OTHER SELECTIONS: Below: Green Tree Frog, *Litoria caerulea* **John Pumpurs**

and

Above: Dainty Tree Frog, *Litoria gracilenta* **Damian White**

Below: Fleay's Barred Frog, *Mixophyes fleayi,* showing prominent webbing between toes **Karen Russell**

more...

Above: Mottled Barred Frog, *Mixophyes coggeri* **Narelle Power**

Below: Tyler's Tree Frog, *Litoria tyleri*, about to leap **Cassie Thompson**

Above: Peron's Tree Frog, *Litoria peronii* resting from a heavy calling session **Samatha Wallace**

Below: Cape Melville Tree Frog, *Litoria andirrmalin*, on rock at night (note huge eyes) **Marion Anstis**

Above: Southern Heath Frog, *Litoria watsoni* **George Madani**

Below: Green and Golden Bell Frog, *Litoria aurea* **Josie Stokes**

The 2021 Frog Epidemic in Eastern Australia

Arthur White

As you all know, 2019 saw the emergence in eastern China of the corona virus labelled COVID-19. It did not take long for the virus to be spread around the globe, claiming millions of lives and closing down national economies. Humans have poured billions of dollars into trying to control the spread of the disease and treat infected people. While this drama was unfolding, a similar scenario has begun playing out in the frog world in eastern Australia. An epidemic has erupted along the eastern coast of Australia during 2021 that has claimed countless frogs. The frog epidemic is serious, but of course, it does not get the media attention of human pestilence. *Why has this frog epidemic occurred*? *Is it similar to other previous epidemics in Australian frogs or is this something new*?

Our frog epidemic begins

First alerts of something wrong in the frog world were received by the Frog Help Line in late May 2021. The first reports were of dead Green Tree Frogs in the Richmond-Windsor area. Four reports in three days. All the reports were similar in that the callers described finding sickly frogs on their lawn in the day time. The frogs were skinny, could hardly move and were very dark in colour (Fig. 1). Sometimes they were alive but died within 24 hours of first being noticed.

Fig. 1 Dead Green Tree Frog **Suzanne McGovern**

The FATS Frog Help Line receives some calls at the start of every winter about skinny, dying frogs. The onset of winter is a tough time for frogs, especially if they are underweight. Every winter, a number of frogs may die because they are forced to undergo long periods without food. If they are already skinny at the start of winter, they will not be able to fend off infections or starvation during the cold months. That has become normal.

What was different this time? Frogs were being found at the start of winter out in exposed areas, sick or dead, even during the daytime.

Healthy frogs normally take shelter throughout the colder months of the year. Food is not available and so frogs find a safe place to hide, reduce their metabolic rate and wait until the temperatures begin to rise again. If they are burrowing frogs, it is time to dig deep into the safety of the soil.

Was this an outbreak of Frog Chytrid Disease?

When these reports were received, the first suspicions were that these frogs were victims of Chytrid. Amphibian Chytrid is not new and has caused widespread frog deaths in Australia and globally before. Chytrid first emerged in Australia as a pandemic in the 1980s. Unlike COVID-19, the pathogen involved is not a virus, but a single-celled fungus. The fungus, formally named (*Batrachochytrium dendrobatidis*) initially penetrates and damages frog skin, resulting in the frog's immune system being impeded and then they become prone to multiple common infections. Chytrid has been responsible for causing population declines in more than 500 amphibian species around the world, and the extinction of more than 70 species.

Not all frogs are equally susceptible to chytrid disease. In Australia, many of the tree frogs (genus *Litoria*) appear to be more susceptible. The last major eruption of frog chytrid disease in eastern Australia was in 1995/1996. Chytrid is widespread in frog communities globally and flares up occasionally as a local outbreak.

The triggers for a major pandemic such as Chytrid are unknown, but usually are the result of a combination of events: frog populations that are stressed by external factors such as sustained adverse weather, lack of food, loss of habitat or habitat degradation are more likely to succumb to an outbreak of Chytrid. In addition, the chytrid organism is capable of change and more virulent

forms of the fungus appear from time to time.

Winter 2021— our frog epidemic worsens

June and July saw FATS Frog Help Line besieged with calls from distressed residents finding dead frogs. Initially the calls were from the Greater Sydney area, but then we received many calls from people in the Hunter Valley. It was clear that there were major eruptions and places such as Singleton, Maitland, Paterson, Dungog, and Muswellbrook were in the firing line. We also started to receive the first calls from people in the Illawarra and Shoalhaven regions, south of Sydney.

FATS were not the only ones receiving this bad news. The Australian Museum and Taronga Zoo in Sydney were also being bombarded with calls about dying frogs. As it was clear that this was not a normal winter-die off, Taronga and the Museum combined forces to establish a task force to deal with the epidemic. **Dr Jodi Rowley** from the Australian Museum (Fig. 2) and **Dr Karri Rose** from the Taronga Zoo established a co-operative arrangement where the Australian Museum dealt with most of the incoming calls and the Australian Registry of Wildlife Health (ARWH) at Taronga Zoo dealt with the analysis of frog carcasses and the identification of pathogens. Shortly afterwards, a forensic unit from the NSW Department of Planning, Infrastructure and Environment (DPIE) also joined the team. There was now a strong and organised front to deal with this epidemic.

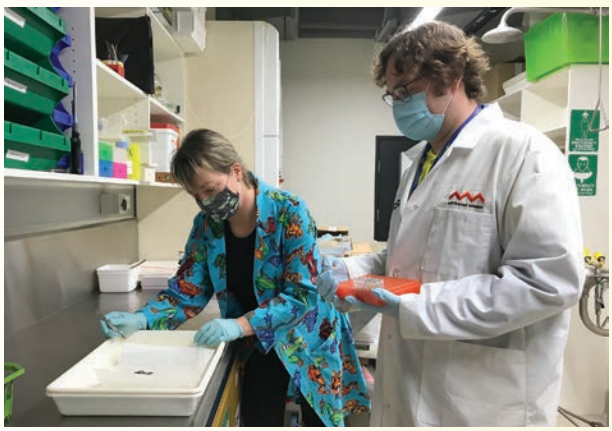

Fig. 2 Jodi Rowley and Dane Trembath examine a dead frog in the Australian Museum

Meanwhile, in Queensland, reports of many frog deaths were also starting to come in. Most of the reports were from south-eastern Queensland. The Queensland Frog Society went public, calling for members of the public to report dead frogs, collect the animal/corpse and forward it to the Dept. of Environment and Science (DES) for analysis.

The winter death Toll

By the end of August 2021, the ARWH had been able to confirm over 1,200 frog deaths in eastern Australia. Of these, about 950 were from NSW, the rest from Queensland. The first reports of frog deaths from Victoria were also starting to come in. The reports that were being received were consistent: people were findings frogs in open areas, sitting still and often lethargic or incapable of moving. The frogs would remain stationary for some time, slowly turning dark brown; their skin would dry out and the abdomen would collapse inwards: the frogs would die usually within 24 hours of being found. Other symptoms that were reported included a red flush in the belly skin of the frog (Fig. 3) and excessive skin sloughing.

Fig. 3 Dead frog with red flush over inner limb surfaces and belly **Sophie Hendy**

Main Regions Affected

It was evident that there some regions that were being affected more than others; the worst hot-spots for frog deaths in NSW were areas on the mid-north coast (between Grafton and Coffs Harbour), the far north coast around Ballina and Yamba, the Lismore area, the Hunter region, the Central Coast (especially around Wyong, Tuggerah Lakes and Morisset), the South coast (Shoalhaven and Illawarra regions). Sites in Queensland that were particularly affected were concentrated around Brisbane, Gympie, Toowoomba, Bundaberg and Gold Coast. In Victoria, the worst sites were in the outskirts of Melbourne and the Gippsland.

Most of the reports received were from heavily populated areas: it is probable that in towns and cities people are more likely to come across dead and dying frogs. It is also likely that many frog deaths are not reported in less populated areas.

What frogs were being affected?

A relatively small range of frog species seemed to be badly affected by the epidemic: most reports initially received concerned dead or dying Green Tree Frogs (*Litoria caerulea*). These frogs are

reasonably large, fairly conspicuous and generally popular with people. Their deaths often prompted some very emotional phone calls. The early phone calls were biased towards these rather iconic frogs. As time went on, the range of species reported increased. To date, over 20 frog species have been recorded as victims of the epidemic: the more common ones Peron's Tree Frog (*Litoria peronii*), the Southern Stony Creek Frog (*Litoria lesueuri*), the Northern Stony Creek Frog (*Litoria wilcoxii*) and the Northern Green Stream Frog (*Litoria phyllochroa*). These are all relatively common and widespread species, which is probably why they have been found in and around our gardens and on our properties. Other rarer species, such as the Green and Golden Bell Frog (*Litoria aurea*) and the Southern Growling Grass Frog (*Litoria raniformis*) have also been affected.

While all of the frogs recorded in this list are tree frogs, some ground frog deaths were also recorded: these included Tusk Frogs (*Adelotus brevis*), Great Barred Frog (*Mixophyes fasciolatus*), Eastern Pobblebonk (*Limnodynastes dumerilii*) and Striped Marsh Frog (*Limnodynastes peronii*). Ground frogs are not as obvious as tree frogs and so are normally less noticed by people. Their relative absence from the list of dead frogs may reflect the fact that their bodies are not being seen. A number of people who reported dead ground frogs stated that the bodies were in bushes or against walls (ie. not out in the open).

Perhaps, the biggest surprise was the finding of dead Cane Toads (*Rhinella marina*). This was surprising as Cane Toads are one of several species known to carry Frog Chytrid disease but generally, not to succumb to it.

Oddities of this Epidemic

The finding of dead Cane Toads in 2021 was just one of a number of odd and niggling differences between this and the 1995/1996 chytrid pandemic. Since 1995/1996 we have not had a widespread outbreak of chytrid. Yes, there have been small, highly localised outbreaks but these have always petered out quite quickly. The response of the Australian frog populations to a pandemic like Frog Chytrid Disease was exactly as you would expect: the initial exposure to the pathogen was dramatic, resulting in high rates of infections and many deaths. As the years passed, infection rates fell and fewer frogs died despite the fact that the disease was now widely established in frog populations. It seemed like chytrid was becoming a disease that caused minor illness and deaths, but was no longer the scourge of frog communities. Some species appeared to be developing a level of immunity to chytrid. For the chytrid organism, killing its hosts is not a long-term method of survival (as the chytrid pathogen dies as well). For the frog, a slowly developed resistance to chytrid was required to negate its debilitating effects on the them. *So, if frogs were more resistant to chytrid, why did this epidemic occur*? *Is it only Chytrid that is responsible for the frog deaths*?

Pathology results Reveal the True Nature of this Epidemic

Our haste to assume that chytrid was responsible for this epidemic was not justified. The teams at the ARWH in Sydney, Melbourne University, Melbourne Ark in Victoria and DES in Queensland were steadily building up a picture of the nature of this epidemic. *The majority of frog deaths were not attributable to frog chytrid disease*. Many other pathogens were detected. The pathologists had to sort through these infections to determine which were causative to the animal's demise and which were secondary infections that attacked the already disease-weakened animal. In general, about 30% of the frogs autopsied to date had chytrid, and of these, most had died from that infection (although many also had secondary bacterial infections). Of the rest, more than 50% were infected with ***Ranavirus***. The remaining 20% had major bacterial diseases or had severe parasite loadings that eventually led to their deaths.

The finding that *Ranavirus* was the major epidemic pathogen was a bit surprising. *Ranavirus*, as the name indicates, is a virus. In Europe and America, *Ranavirus* has been responsible for mass frog deaths. Ranaviruses have been identified in a range of ectothermic vertebrates, including fish, amphibians (frogs, toads, salamanders) and reptiles (lizards, turtles, snakes). Some types of *Ranavirus* are capable of infecting a broad range of species.

Afflicted Green Tree Frog found near Kempsey, NSW, June 2021; note red flush over belly and inner limbs **Kate Shaw**

Ranavirus has been recorded in Australia before (e.g. in the 1980s), but when it first entered Australia is unknown. Why *Ranavirus* has not become an epidemic before in Australia as it has done elsewhere in the world, has been a great mystery. Perhaps our time was up. Studies on *Ranavirus* elsewhere in the world have found the *Ranavirus* is spreading. Not only is it appearing in new countries and new locations, but it is also infecting new hosts.

In Australia, prior to 2021, most evidence of *Ranavirus* was detected by the presence of antibodies to Ranavirus in the frog's blood. Disturbingly, the antibodies to *Ranavirus* are most commonly found in the blood of cane toads. There was a real possibility for Cane Toads to act as dispersal agents of *Ranavirus*, passing it to native frog communities, but this does not seem to have happened. We do not know why.

The recorded cases of native frog deaths to *Ranavirus* prior to 2021 were metamorphs of *Limnodynastes ornatus* and adult *Litoria caerulea* from Townsville, and captive juvenile *Pseudophryne coriacea* from Sydney. Tadpoles appeared to be the most susceptible, and juvenile frogs were more susceptible than adults.

The range of bacteria reported as causing disease and death in amphibians is also small. However, in frogs infected with chytrid or *Ranavirus*, secondary bacterial infections commonly occur and bacterial septicaemia often results. Infections from Group B *Streptococcus*, *Aeromonas*, *Flavobacteria*, *Chlamydia* and *Mycobateria* were all present in the frog autopsied in 2021.

Monitoring *Ranavirus* overseas

Ranavirus outbreaks overseas have been most prevalent in conservation areas, such as national parks and wildlife reserves. This is not because these areas are unhealthy, quite the opposite. These areas often provide the only viable remaining habitat for many frog species in an increasingly urbanised world. In Spain, 15 national parks have been monitored for *Ranavirus* and Chytrid since 2003. Frogs in these national parks live with both Chytrid and Ranaviruses and the study was aimed at finding out what the long-term effects of these two pathogen complexes is on frog populations. Chytrid is a generalist pathogen that has driven declines and extinctions across a broad range of amphibian host species. The fungus is able to infect over 50% of all tested amphibian species, with over 1,000 confirmed host species in at least 86 countries to date. In contrast, ranaviruses are still an emerging group of pathogens, but already have a host range spanning all ectothermic vertebrates. Ranaviruses are becoming more prevalent and are increasingly associated with mass amphibian die-offs overseas.

The study found that *Ranavirus* was implicated in more frog deaths than chytrid and that Ranaviruses have a greater potential to vary their method of infection, their host and their potency. In short, *Ranavirus* has been underestimated as a threat to global frog communities because its pathogenicity is often masked by secondary infections.

What triggered our 2021 epidemic?

At this point in time, we don't know. The very cold snap at the start of this winter is believed to be a telling factor and may help explain the early appearance of dead and dying frogs. We know that water temperature, for example, has a profound effect on the susceptibility of frogs to chytrid infection. What effects ambient temperature has on Ranaviruses is still to be resolved. Many other factors could be responsible for this epidemic, including new host species, the decline in insect food loads in eastern Australia (weakening the frogs), increased habitat degradation and climate change. It is also possible that the devastating and widespread bush fires of 2019–2020 may have contributed to the epidemic, since the epidemic was most pronounced along the edges of the bushfire-affected areas in eastern Australia.

The Future

This epidemic will provide much useful information for future disease management in wild frog populations in Australia. While data is still being processed, we can only hope new facts will emerge that may shed light as the trigger of this outbreak and how best to protect frog populations for future outbreaks.

Dead Northern Green Stream Frog, *Litoria phyllochroa*, observed in the wild **Isabella Bain**

Further notes on the Endemic Tasmanian Tree Frog, *Litoria burrowsae*

Craig Broadfield

Here is little more to add to the ongoing Tasmanian Tree Frog, *Litoria burrowsae* puzzle. See FATS FrogCall newsletter 170, December 2020 pages 30 and 31 for previous notes. This is my first encounter with an egg cluster from this somewhat cryptic species. The eggs were a cluster of heavily tannin-stained, large individual egg sacs (e.g. individual capsule diameter about 9-11mm, egg diameter 2.5-2.7 mm), and noticeably larger than the size of Tasmania's only other true tree frog species, *Litoria ewingii* (e.g. capsule diameter 6-7mm, egg diameter 1.5-1.6 mm). Emerging hatchling tadpoles are also larger than the size of *Litoria ewingii* hatchling tadpoles. The eggs were laid in semi-permanent or permanent pools amidst button grass and tea-tree (*Melaleuca*) heathland environment, on the West-Coast of Tasmania.

They are a very colour-variable species. Youngsters don't start to green up for some months (apparently). Time will tell. They are a surprisingly large frog. Adult males seem to average

Adult male Tasmanian Tree Frog, *Litoria burrowsae* **Craig Broadfield**

around 65mm with one individual recorded at 80mm. Although I've not yet sighted an adult female, it could be reasonably assumed they could measure up to 80 or perhaps up to 100 mm. These measurements are larger than current supporting documentation on the species.

L. burrowsae embryos in tannin-stained capsules. Single hatched embryo at lower right **Craig Broadfield**

Recently metamorphosed *Litoria burrowsae*. Green colours as yet not present **Craig Broadfield**

Adult male *Litoria burrowsae* showing variable colouration **Craig Broadfield**

Field Trips

***Please book your place on field trips*. Due to strong demand, numbers are limited. Be sure to leave a contact number. Regardless of prevailing weather conditions, we will schedule and advertise all monthly field-trips as planned. It is YOUR responsibility to re-confirm in the last few days as to whether the field trip is proceeding or has been cancelled. Phone Robert Wall on 9681 5308.**

Sunday 5th December 2021: Australian Reptile Park, Somersby Annual Herpetological Groups Christmas BBQ, host John Weigel; ph (02) 4340 1022. Email: admin@reptilepark.com.au

This event is open to all members of herpetological societies. Free entry, but you must present your FATS membership card upon entry. A great opportunity to wander around and check out all the exhibits. There are BBQ facilities available, or there is food available at the kiosk. No bookings required. (Given the present Covid circumstances, it is perhaps advisable to ring the Reptile Park the day before to check on the status of this function).
Meet at Wentworth Common carpark. The carpark is in Marjorie Jackson Parkway, about 150m from the intersection with Bennelong Parkway.

Saturday January 8th, 2022. 1.30pm-4pm. Darkes Forest Tadpole Hunt.
Leader: Marion Anstis. Take the Princes Hwy south (not the freeway), then take the Darkes Forest Rd turn-off. Meet 200m from the corner.

Have some lunch before you arrive, but it will be good to have some snacks and water with you, plus bring a hat and sunscreen. If you bring boots to enter shallow water areas, please ensure that they are clean, have been sterilised with bleach **and are dry** before you bring them. We don't want bleach entering the water. There will be a wash bowl provided with bleach there for your land shoes to be dipped in on the day.

Tadpoles are an important indicator of local frog populations. By examining which tadpole species are present, we can infer with great certainty which adult species are present in the vicinity. Importantly, looking for tadpoles can also be easily carried out in the daytime. At some sites, this can make frog surveying a great deal safer and easier. This is an important consideration for both enthusiasts and professional ecological consultants.

Tadpoles though, can be tricky for the newcomer to identify. Today, Marion will take us through some of the clues which will help you identify the species that are known from this area, that we might encounter. She will also explain the seasonal and breeding considerations we need to take into account when we are looking for tadpoles. Because we will start at 1.30pm and finish approximately around 4.00pm during daylight hours, there will be no night-time spotlighting on this outing.

Marion is the author of the definitive guide to Australian tadpoles and frogs, *Tadpoles and Frogs of Australia* (New Holland Publishers, 2017 (second edition)), and is perhaps the ultimate authority on Australian tadpoles. She has travelled extensively around Australia researching our tadpole and frog fauna. She may even be coaxed into telling us about some of her hair-raising adventures while looking for some of our most remote and elusive tadpoles!

FATS hopes to be able to include one or more field trips in 2022, but we will know more about these when the Covid regulations for next year become stabilised and there are no further lockdowns.

NB: In the event of uncertain frogging conditions (e.g. prolonged/severe drought, hazardous and/or torrential rain, bushfires etc.), please phone 9681-5308. Remember: rain is generally ideal for frogging! Children must be accompanied by an adult. Bring enclosed shoes that can get wet (gumboots are preferable), torch, warm clothing and raincoat. Please be judicious with the use of insect repellent – frogs are very sensitive to chemicals. Please observe all directions that the leader may give. Children are welcome, however please remember that young children especially can become very excited and boisterous at their first frogging experience – parents are asked to help ensure that the leader is able to conduct the trip to everyone's satisfaction. All field trips are strictly for members only – newcomers are however, welcome to take out membership before the commencement of the fieldtrip. All participants accept that there is some inherent risk associated with outdoor fieldtrips and by attending agree to; a release of all claims, a waiver of liability, and an assumption of risk.

Directions to Meetings
FATS meets at 7pm, on the first Friday of every EVEN month at the **Education Centre, Bicentennial Park, Sydney Olympic Park.**

An easy walk from Concord West railway station and straight down Victoria Ave. By car: enter from Australia Ave at the Bicentennial Park main entrance, turn off to the right and drive through the park. It's a one way road. Just follow it and turn right at the P10f parking sign. Or you can enter from Bennelong Road/Parkway. It is a short stretch of two-way road. Park in P10f car park, the last car park before the Bennelong Rd exit gate. Take a good torch in winter. It is a short walk from the car park to the Education Centre, Bicentennial Park. It is a short walk to the single story education centre and its tall tower. Both can be seen from the car park. Directions from your home: **http://www.sydneyolympicpark.com.au/maps/getting-to-the-park?type=venue&id=384059**
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THANK YOU to the committee members, FrogCall supporters, meeting speakers, Frog-O-Graphic competition entrants, events participants & organisers, David, Kathy and Harriet Potter, and Sarah and Ryan Kershaw. The FrogCall articles, photos, media and webpage links, membership administration and envelope preparation are all greatly appreciated. Special thanks to the many newsletter contributors, Robert Wall, George Madani, Jilli Streit, Karen & Arthur White, Andrew Nelson, Michelle Toms, Josie Styles, Jodi Rowley, Steve Weir, Wendy & Phillip Grimm and Marion Anstis. Special thanks also to Marion Anstis who has produced our glossy colour collector's edition of FrogCall each December.

FATS meetings commence at 7 pm, (arrive from 6.30 pm) and end about 10 pm, at the **Education Centre, Bicentennial Park, Sydney Olympic Park, Homebush Bay.** They are held on the first Friday of every EVEN month February, April (except Good Friday), June, August, October and December. We hold 6 informative, informal, topical, practical and free meetings each year. Visitors are welcome. We are actively involved in monitoring frog populations, field studies and trips, have displays at local events, produce the newsletter FROGCALL and FROGFACTS information sheets. Please contact Events Coordinator Kathy Potter if you can assist as a frog explainer at any event, even for an hour. No experience required. Encourage your frog friends to join or donate to FATS. Donations help with the costs of frog rescue, student grants, research and advocacy. All expressions of opinion and information in FrogCall are published on the basis that they are not to be regarded as an official opinion of the FATS Committee, unless expressly so stated.

FATS ON FACEBOOK: FATS has nearly 4,000 Facebook members from across the world. Posts vary from husbandry, disease and frog identification enquiries, to photos and posts about pets, gardens, wild frogs, research, new discoveries, jokes, cartoons, events and habitats from all over the world. The page was created 10 years ago and includes dozens of information files – just keep scrolling to see them all. https://www.facebook.com/groups/FATSNSW/

RESCUED FROGS are at our meetings. Contact us if you wish to adopt a frog. A cash donation of $50 is appreciated to cover care and feeding costs. We have no EFTPOS. FATS must sight your current amphibian licence. NSW pet frog licences can be obtained from the NSW Department of Planning, Industry and Environment (link below). Please join FATS before adopting a frog. This can be done at the meeting. Most rescued frogs have not had a vet visit unless obviously sick. Please take your formerly wild pet to an experienced herpetological vet for an annual check-up and possible worming and/or antibiotics after adoption. Some vets offer discounts for pets that were rescued wildlife. **https://www.environment.nsw.gov.au/licences-and-permits/wildlife-licences/native-animals-as-pets/frog-keeper-licences**

NB: FATS has student memberships for $20 annually with electronic FrogCall (but no hard copy mail outs). https://www.fats.org.au/membership-form

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