






New Zealand native frogs: a special tribute to honour Phil Bishop (1957–2021) for his dedication and contribution to frog research and conservation

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Figure 1. Emeritus Professor Phillip J. Bishop (1957–2021).

The conservation world is full of passionate people, but among these, there are the stars. The handful of people whose enthusiasm is infectious. The people who take the time to make every person feel important whether they are a first-year undergraduate student, a Wellington politician, a philanthropist, a concerned member of the public, or a world-famous celebrity. They are the ones who can make the ordinary seem extraordinary, who can inspire the people around them. The people who, through their hard-work, grit,

and determination, can enact change on local, national, and international levels. They are the warriors of conservation who move us forward against the never-ending challenges of climate change, human population growth, and habitat destruction; who never give up despite the odds. But even these superstars cannot burn bright forever. On 23 January 2021 at the age of 63, we lost one of these amazing stars: Emeritus Professor Phillip J. Bishop (Fig. 1).

Phil was an amazing scientist, conservationist, teacher, and colleague. He was due to become Head of the Zoology Department at the University of Otago at the time of his death. He was also at the forefront of amphibian conservation and a scientific advisor for some of the world's most influential conservation organisations including the International Union for the Conservation of Nature, the Zoological Society of London's EDGE programme, Amphibian Ark, the Amphibian Survival Alliance, and co-chair of the Amphibian Specialist Group. Phil was a scientist who authored over 100 scientific publications and supervised nearly 50 postgraduate students. He was awarded numerous accolades including the inaugural National Conservationist of the Year Award in 2008, an IUCN Citation of Excellence in 2019, a Lifetime Achievement Award from the New Zealand International Science Festival in 2018, and several awards for his inspiring university-level teaching. Since his untimely death, there have been two frog species named in his honour, *Leiopelma bishopi* and *Stumpffia bishopi* (Easton et al. 2022; Rakotoarison et al. 2022).

Phil's research spanned the globe, though his greatest focus over the last two decades was on New Zealand frogs. His passion was in amphibian conservation whether that was researching the specifics of translocations, the ecology and cures for the amphibian fungal disease chytridiomycosis, frog communication and behaviour, or a host of other topics. He also published repeatedly with colleagues from around the world on topics of international importance such as climate change, conservation planning, and the amphibian extinction crisis. Additionally, Phil was involved from its inception in the

establishment of the Orana Wildlife Park Amphibian House, a state-of-the-art facility housing Hamilton's frogs. He led the 9th World Congress of Herpetology, which was hosted in Dunedin in January 2020 bringing scientists to New Zealand from all over the world. Phil also authored "Croak – a book of fun for frog lovers", which was released just months after his death, but serves as a reminder to continue his mission.

A CV full of publications, research grants and accomplishments can never truly do justice to Phil's spirit. His passion for frogs was infectious, as was his sense of humour, his empathy, and his kindness. He was a leader in both education and conservation. Phil was also a tireless advocate for the little creatures that he had devoted his life's work to.

This special issue of the *New Zealand Journal of Ecology* focuses on the ecology and conservation of New Zealand's endemic frogs (Archaeobatrachia: Leiopelmatidae). The twelve papers that follow are dedicated to the memory of Phil Bishop. Many of the papers are from work that he left unfinished at the time of his unexpected death. Others are authored by Phil's students and colleagues. With Debbie Bishop, Phil's wife, five of us, all with experience in New Zealand frog research and conservation, formed the editorial team. We followed the format and standard of the *New Zealand Journal of Ecology*.

We thank the reviewers who independently assessed each manuscript and the New Zealand Ecological Society for providing the opportunity for publishing these papers as a tribute to the late Phil Bishop. We are particularly indebted to the Department of Conservation and especially to Dr Avi Holzapfel for securing necessary funding to cover production costs of the issue.

The papers that follow focus on the three extant archaic frogs (Anura: Leiopelmatidae) endemic to New Zealand: Archey's frog (*Leiopelma archeyi*), Hamilton's frog (*L. hamiltoni*), and Hochstetter's frog (*L. hochstetteri*). The many authors represent a cross-section of those involved in New Zealand frog research and conservation, including Phil Bishop's post-graduate students past and present, while the papers cover a varied range of topics that demonstrate the diverse range of current interests in endemic frogs in New Zealand. Each of the 12 papers was assessed by two independent reviewers. Eleven were research papers and one was a review paper. In the introductory summary below, the scope of each paper is briefly outlined, but the findings are left for the reader to discover in the papers that make up this special issue.

The first paper (Hotham et al. 2023) examines *L. archeyi* abundance in relation to habitat disturbance in the Coromandel Peninsula from paired-sample abundance estimation from two sites, each comprising of an area which had been disturbed (at least 50% of vegetation removed) by mining exploration or urbanisation during the past 40 years, and an area that remained undisturbed over the same period of time. In the second paper (Bell & Pledger 2023), post-metamorphic body growth and longevity in *L. archeyi* and *L. hamiltoni* are described based on long-term capture-recapture studies in the Coromandel Peninsula (1982–2021) and on Te Pākeka/Maud Island (1983–2021) respectively. Papers three and four both consider predator control, the first (Germano et al. 2023a) reporting age dependant effects of rat control on *L. archeyi* at Whareorino, New Zealand, with population modelling being used to investigate whether ongoing rat suppression has an effect on the rate of independent juveniles produced per adult frog, survival, and on adult abundance over time. In the fourth paper, Crossland et al. (2023) investigate whether

predator control to protect a native bird (North Island kokako, *Callaeas wilsoni*) in the Hunua Ranges would also benefit *L. hochstetteri* using site-occupancy modelling. In the fifth paper, Eda et al. (2023) document the prevalence in endemic frog species in New Zealand of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* (Bd) from 2014–2021. Skin swabs from 324 frogs were collected from six sites in New Zealand and analysed using qPCR to detect Bd. The suitability of radio telemetry for monitoring *L. hamiltoni* and *L. archeyi* is examined by Altobelli et al. (2023) in the sixth paper, where the authors describe trials of a waist-harness style radio telemetry package for use on these frogs. In the seventh paper, Cisternas et al. (2023) investigate the use of dead tree-fern trunks as oviposition sites by *L. archeyi*, examining whether previous observations of this behaviour were random or whether ponga was a breeding resource consistently used by *L. archeyi*. Colour variation and behaviour of the cryptic *L. archeyi* are examined in the eighth paper (Powell et al. 2023); using data obtained between 2017 and 2021 at Wharekirauponga in the Coromandel Forest Park, they investigate if *L. archeyi* demonstrates colour crypsis by background-matching, and whether green pigmentation is lost as frogs age. Powell et al. (2023) also examine the height above ground at which frogs are found. Climate change is the focus of the ninth paper by Germano et al. (2023b), modelling *Leiopelma* species distribution in New Zealand under a changing climate and noting that amphibians are considered susceptible to a range of potential effects generated by climate change. The final three papers describe conservation translocations of endemic frogs in New Zealand. The tenth paper (Germano et al. 2023c) measures the responses at the source and release site following an inter-island translocation of *L. hamiltoni* from Te Pākeka/Maud Island to Long Island, Marlborough Sounds. In the eleventh paper, Karst et al. (2023) report on successive translocations of Te Pākeka/Maud Island *L. hamiltoni* to a mainland sanctuary (Zealandia) occupied by house mice (*Mus musculus*). The outcome of this first attempt to restore the species to the mainland is described. All non-native mammals had been eradicated from the translocation site, but house mice (*Mus musculus*). The twelfth concluding paper (Wren et al. 2023) is a detailed review of all New Zealand endemic frog translocations to date, addressing the lessons learned and outlining future translocation priorities. The authors review ten translocations of *Leiopelma* frogs, occurring between 1924 and 2016.

While New Zealand's frogs have lost one of their strongest and most vocal advocates, the papers in this issue illustrate the projects, people and ecological knowledge that were all touched by Phil Bishop's life and work. He has left a legacy of work and wisdom that will continue for years to come. He will never be forgotten by those of us that were lucky enough to know him.

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