

Science for Saving Species

Research findings factsheet

Project 2.1



National Environmental Science Programme

The Australian frogs most at risk of extinction and the actions needed to save them

In brief

This project has identified the Australian frog species at greatest risk of extinction, the likelihood of extinctions by 2040 with no improvements to management, and the highest priority management actions needed to prevent extinctions.

We examined 26 frog species previously identified as meeting Critically Endangered or Endangered criteria on the IUCN Red List. We used available data on ecology, threats and trends, and then 28 researchers with varying skills and backgrounds participated in an elicitation process.

We found that four of the 26 species may already be extinct. Four more species are more likely than not (>50% probability) to become extinct by 2040 unless there are substantial improvements in resourcing, monitoring and management. An additional five species have a moderate to high (30–50%) probability of extinction before 2040.

We identified species at risk in every state and territory except South Australia and Tasmania. Most of the imperilled species, including 10 of the top 15, are found in Queensland. New South Wales has nine species. Many are found only in small areas.

The amphibian fungal disease chytridiomycosis and climate change are the primary threats to Australian frogs. For some species, habitat loss, invasive fish and pigs are also major threats.

Urgent management actions are required to prevent extinctions of Australian frogs. Key priorities include developing captive breeding and management programs and establishing wild population refuges, where the impacts of disease, climate change and pest species are reduced sufficiently to allow populations to survive.

Background

More than one-third of the world's amphibians are listed as threatened or extinct. This is a greater proportion than for mammals, birds, reptiles and fish. Even in areas with reasonably intact habitat there have been major declines.

In Australia, chytridiomycosis, the disease caused by chytrid fungus (*Batrachochytrium dendrobatidis*) has been implicated in the decline of 43 species, representing nearly one-fifth of the country's amphibian diversity. It is also the primary cause of the known extinctions to date.

Climate change has also been identified as an emerging major threat, especially for range-restricted montane frogs. Many frog species are restricted to the uplands of mountains along the east coast of Australia, especially in the north-east. Cool, moist environments also provide the optimal conditions for pathogen growth; subsequently, these montane, stream-dwelling frogs are at the greatest risk from chytridiomycosis.

Habitat loss and invasive species (particularly fish and feral pigs) are significant threats for some

Australian species due to predation and habitat destruction.

The IUCN Red List is the most widely used tool for measuring extinction risk to biodiversity globally. The list does, however, have limitations for identifying and prioritising species at immediate risk of extinction, such as determining relative risks between multiple Critically Endangered species. For this reason, there is value in undertaking an additional process that more explicitly estimates extinction probability within the near future, as this will assist in allocating resources to prevent extinction.







The most imperilled Australian frogs (from top, left to right):

#1 The northern gastric-brooding frog (*Rheobatrachus vitellinus*) is likely already extinct, primarily due to chytrid fungus disease. Image: Hal Cogger

#2 The mountain mist frog (*Litoria nyakalensis*) is likely already extinct, primarily due to chytrid fungus disease. Image: Stephen Richards

#3 The yellow-spotted tree frog (*Litoria castanea*) is likely already extinct. It is sensitive to chytrid fungus disease and also impacted by climate change, habitat loss and invasive fish. Image: David Hunter / DPIE NSW

#4 Northern tinker frog (*Taudactylus rheophilus*) is likely already extinct. Chytrid fungus disease has been the main cause of declines but climate change has also played a role.

#5 The Kroombit tinker frog (*Taudactylus Pleione*) is close to extinction. Without new action it is deemed far more likely than not (70% chance) to become extinct by 2040. It is threatened by chytrid fungus disease, feral pigs and climate change. Image: HB Hines / Queensland Parks and Wildlife Service.

#6 The southern corroboree frog (*Pseudophryne corroboree*) is close to extinction. Without new action it is deemed more likely than not (66% chance) to become extinct by 2040. It is very vulnerable to chytrid fungus disease. Image: David Hunter / DPIE NSW

#7 The Baw Baw frog (*Philoria frosti*) is close to extinction. Without new action it is deemed more likely than not (65% chance) to become extinct by 2040. The main threat to this species is chytrid fungus disease followed by changed climate and fire. Image: Damian Goodall

8 The armoured mist frog (*Litoria lorica*) is among the top 10 Australian frogs at risk of extinction by 2040. Populations were decimated by chytrid fungus disease. Without effective action it is likely to become extinct within 20 years. Image: Conrad Hoskin

#9 The mountain-top nursery frog (*Cophixalus monticola*) is among the top 10 Australian frogs at risk of extinction by 2040. The species is found on a single mountain-top and is threatened by climate change. Image: Conrad Hoskin

#10 The beautiful nursery frog (*Cophixalus concinnus*) is restricted to the top of Thornton Peak, in the Daintree rainforest of north Queensland. It is threatened by climate change. Image: Conrad Hoskin

#11 The northern corroboree frog (*Pseudophryne pengilleyi*) is badly impacted by chytrid fungus disease and its alpine habitat was burned in the 2019-20 bushfires. The ACT Government has a captive breeding program underway and is working with The Australian National University to identify of wild refuge sites. Image: David Hunter / DPIE NSW

#12 The spotted tree frog (*Litoria spenceri*) is found in Victoria and New South Wales. It is badly impacted by chytrid fungus disease and predation of tadpoles by introduced trout species. Image: Michael Williams/Its a Wildlife

#13 The Kroombit tree frog (*Litoria kroombitensis*) is restricted to Kroombit Tops in south-eastern Queensland and is threatened by chytrid fungus disease and climate change. Image: HB Hines / Queensland Parks and Wildlife Service

#15 The Kuranda tree frog (*Litoria myola*) is found in a very small area near Cairns and is unusual on the list in that the primary threat is loss and degradation of habitat due to development. Image: Conrad Hoskin

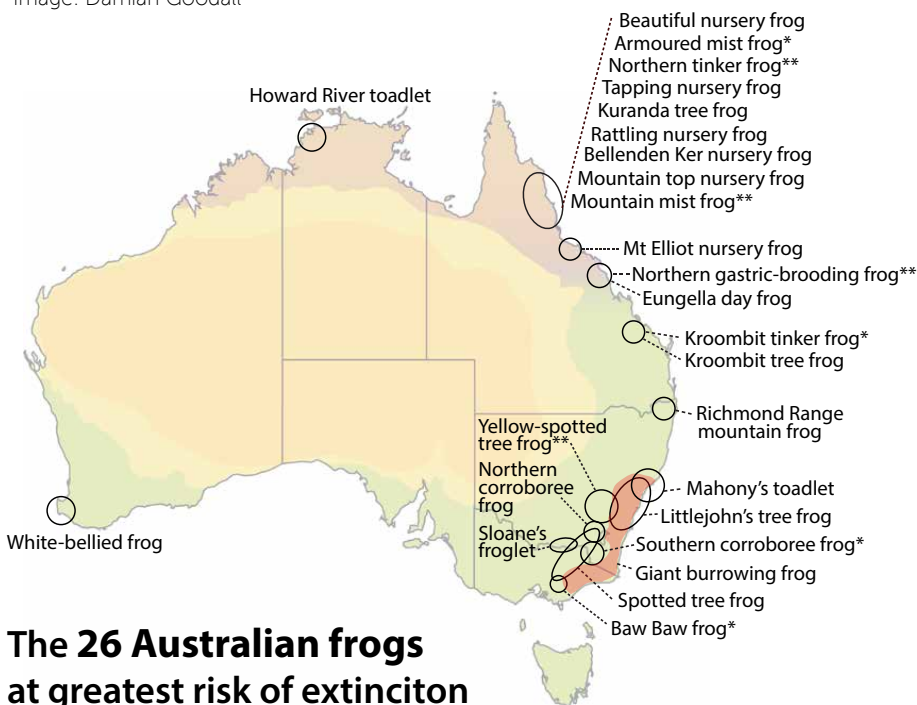
#20 The white-bellied frog (*Geocrinia alba*) is the Western Australian frog at greatest risk of extinction. The tadpoles of this tiny terrestrial breeding frog rely on wet soil to develop. Reduced rainfall in south-west Western Australia is believed to be a major contributor to the decline of this species over recent decades. Image: Emily Hoffmann

#21 Littlejohn's tree frog (*Litoria littlejohni*) only occurs in relatively undisturbed forested areas with infrequent natural fires. Increased bushfire frequency may be the cause of its disappearance from national parks around Sydney. Chytrid fungus disease is also strongly implicated in the decline of this species. Image: David Hunter / DPIE NSW

Watson's tree frog (*Litoria watsoni*) was recently separated from Littlejohn's tree frog (*Litoria littlejohni*) as a distinct species. It is threatened by logging, hot fires and probably also chytrid fungus disease. It is at high risk of extinction. Image: Matthew West

#22 Sloane's froglet (*Crinia sloanei*) was once found over a wide area within the Murray-Darling Basin. It has suffered extensive declines due to habitat loss and degradation. Image: David Hunter / DPIE NSW

#25 The giant burrowing frog (*Heleioporus australiacus*) is threatened primarily by habitat loss and altered fire regimes. Image: David Hunter / DPIE NSW



MAP: The locations of the top 26 Australian frogs at risk of extinction. ** Species likely to be recently extinct. * Species more likely than not to become extinct by 2040 unless there is action. Image: Threatened Species Recovery Hub

The 26 Australian frogs at greatest risk of extinction

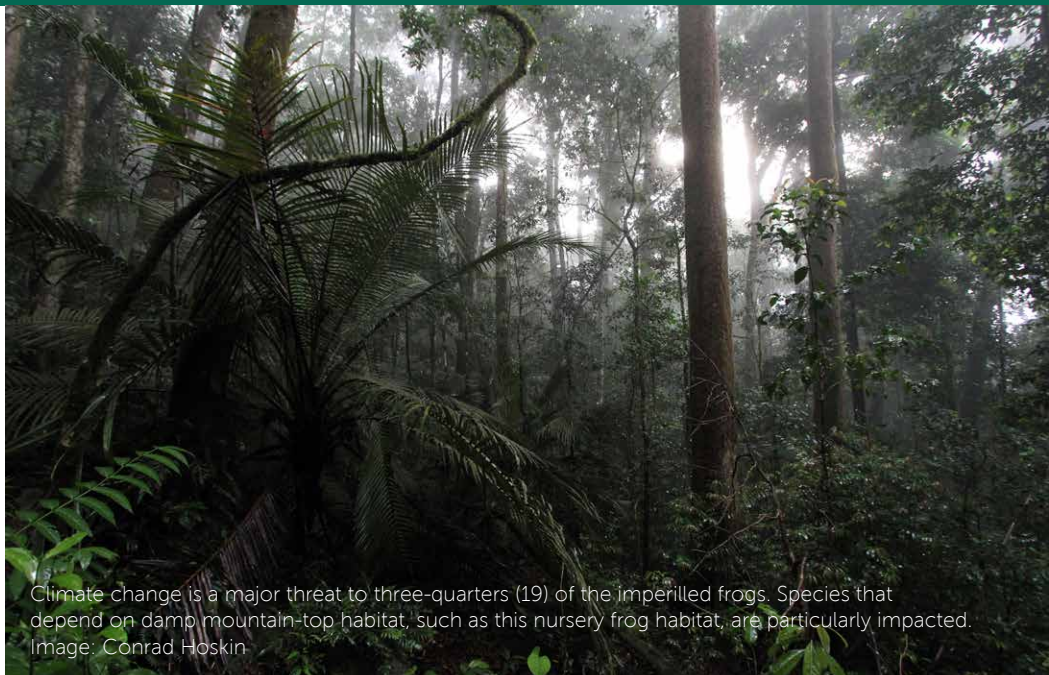




Research aims

We aimed to identify the Australian frog species at greatest risk of extinction, and to estimate their probabilities of extinction in the wild by 2040.

We also aimed to identify the highest priority regions, research areas and management actions to prevent any future extinctions of Australian frogs.



Climate change is a major threat to three-quarters (19) of the imperilled frogs. Species that depend on damp mountain-top habitat, such as this nursery frog habitat, are particularly impacted. Image: Conrad Hoskin

What we did

Our study focused on 26 highly imperilled frog species. This included 22 species identified as meeting IUCN (International Union for the Conservation of Nature) Red List criteria as Endangered or Critically Endangered in a recent review of the conservation status of all 243 Australian frog species. We also included four possibly extinct species because surveys have not been undertaken in important parts of their potential ranges, which means they could be persisting as small populations in remote areas.

We gathered all available information on the frogs' ecology, threats, and trends. We provided this information to a panel of 28 experts, which included researchers and frog biologists from academic institutions, state or federal government agencies and NGOs from every Australian state and territory.

We used a structured expert elicitation method to ask panel members to estimate the probability of extinction in the next 20 years.

We also asked participants to provide a level of confidence associated with this estimate based on the available information. Assessments were based on the assumption that there would be a continuation of current management with no new actions implemented beyond what is currently occurring.

For the four possibly extinct species, we first asked participants to estimate the probability that each of these species is already extinct. We then asked participants to assume that one or more undiscovered populations persists, and to assess extinction probability by 2040.

We obtained information on threats, research and management actions from published literature. Research and management actions were scored based on extinction probability, relative value, feasibility and current level of implementation. This allowed for prioritisation of the most important actions.

We mapped the distribution of the most imperilled frogs to identify regions with many highly threatened species.

Invasive species, especially invasive fish and feral pigs, are a threat to 10 of the frog species. For example, predation of tadpoles by brown and rainbow trout has caused declines of spotted tree frog populations. Image: Aaron Gustafson CC BY SA 2.0



RIGHT: Mountain-top frog habitat in north Queensland.
Image: Conrad Hoskin



Key findings

The findings of this study indicate a dire situation for Australia's most threatened frogs. We found that four species are likely already extinct. Four more species have a greater than 50% probability of extinction. Seven species are more likely than not to become extinct by 2040 unless there are substantial improvements in resourcing, monitoring and management.

Probably extinct already

Of the 26 frog species examined, we found that four species are highly likely to be extinct already. This includes the northern gastric-brooding frog (*Rheobatrachus vitellinus*), mountain mist frog (*Litoria nyakalensis*), yellow-spotted tree frog (*Litoria castanea*) and northern tinker frog (*Taudactylus rheophilus*).

Nevertheless, there remain some poorly surveyed areas within their ranges, and there is a small possibility that remnant populations may be discovered. There are

Australian and global examples of 'missing' frogs being rediscovered in recent decades. Targeted surveys are thus a high priority, particularly in areas that are likely to provide refuge from disease-driven declines.

If there are surviving undetected populations of any of these species, the panel of experts considered that without major new action the future outlook is very poor, with probabilities of extinction surpassing 90% by 2040 for all four species.

The amphibian fungal disease chytridiomycosis is the primary threat to these four species.

Next at greatest risk

A further four species were considered more likely than not (greater than 50% probability) to go extinct by 2040 if only current management continues. These include the Kroombit tinker frog (*Taudactylus pleione*), southern corroboree frog (*Pseudophryne corroboree*), Baw Baw frog

(*Philoria frosti*) and armoured mist frog (*Litoria lorica*). Chytridiomycosis is also the primary threat to these four species.

An additional five species are at moderate to high risk of extinction (30–50%) without improvements to current management practises. The primary threats to these species are climate change, chytridiomycosis and invasive fish.

Locations

Most of the 26 threatened frogs are endemic to a single state or territory, with the majority occurring only in Queensland. The regions with the most at-risk species are:

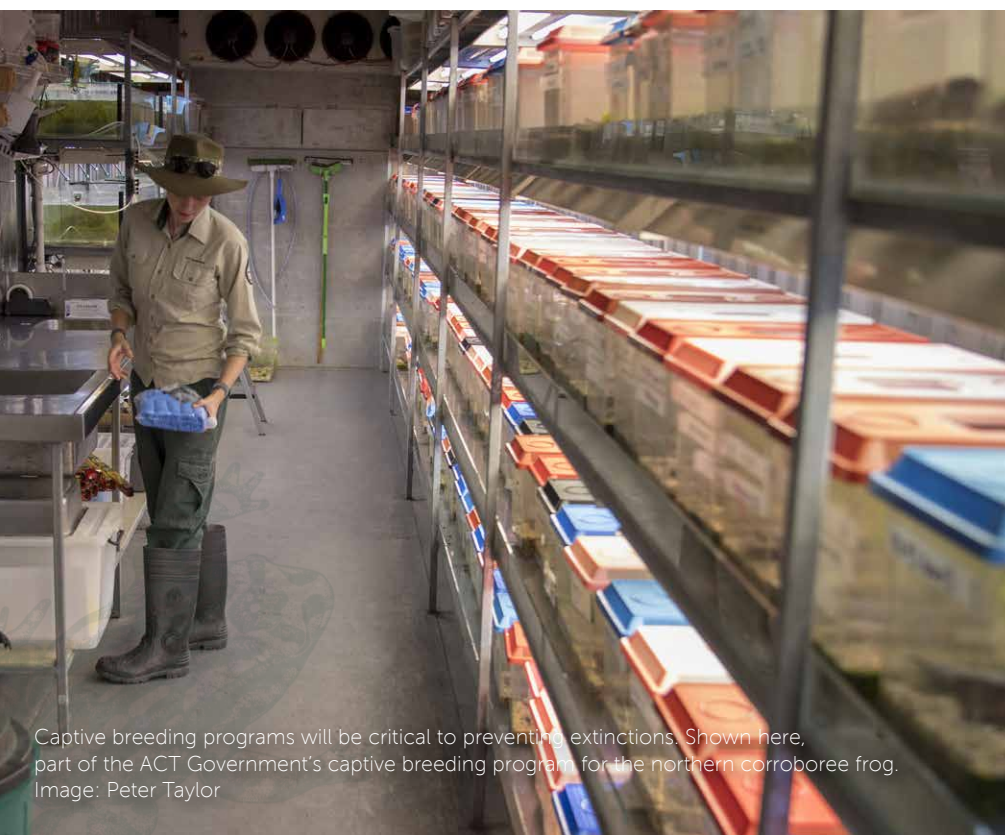
- Queensland wet tropics - 9 species
- Queensland south-eastern - 3 species
- Queensland central Mackay coast - 2 species
- Australian Alps (NSW/VIC) - 3 species

Ten of the top 15 most threatened frogs are restricted to Queensland.

Threats

The most prevalent threats facing the 26 frogs considered are:

- climate change - 19 species
- chytridiomycosis - 15 species
- changing fire regimes - 13 species
- habitat loss - 11 species
- invasive species (primarily invasive fish and pigs) - 10 species



Captive breeding programs will be critical to preventing extinctions. Shown here, part of the ACT Government's captive breeding program for the northern corroboree frog.
Image: Peter Taylor



Dr Matthew West surveying spotted tree frogs in Victoria. Image: Michael Williams It's a wildlife photography

Key findings (continued)

Management priorities

To both prevent extinctions and support populations to survive in the wild, the most important management actions are:

- developing and supporting captive breeding and management
- establishing and/or extending wild population refuges that alleviate impacts from diseases, climate change and non-native fish.

There has been great progress for threatened frogs in Australia, demonstrated through population supplementations, re-introductions and provision of insurance populations for several species. Additionally, gene banking technologies have been developed and implemented for threatened frogs, potentially enabling future reintroduction and supplementation of genetically diverse wild populations.

Climate change and chytridiomycosis are the biggest threats to the surviving species on our list. Currently, options are limited for directly mitigating either of these threats, though research on refuges offers hope to identify sites where species may persist in the wild. Additionally, research investigating gene-mixing offers hope to increase the drying tolerance of some species.

Some of the other threats (e.g., invasive species) are more feasible to manage with existing knowledge and thus should be prioritised. Doing so may make it more likely that populations can persist despite disease or climate change impacts.

The most important research actions needed for these 26 species are investigating and identifying wild population refuges, and undertaking surveys and/or modelling to improve knowledge of species distributions, ecological requirements and conservation status.

How do frogs compare?

Estimated extinction probabilities for frogs are similar to results for birds and terrestrial reptiles, higher than for mammals, and lower than for freshwater fish using the same methods.

Similar levels of imperilment predicted for frogs, birds and terrestrial snakes and lizards could be due to these species all occupying very restricted ranges, and consequently being highly susceptible to random events such as the 2019–20 megafires across the eastern Australian coast. They are also vulnerable to many of the same threats (e.g., climate change and invasive species), although chytridiomycosis is unique to amphibians.



RIGHT: Chytrid disease has killed this green-eyed tree frog.
Image: Rob Puschendorf



Table 1: The 26 Australian frogs at greatest risk of extinction; their estimated probabilities of extinction in the wild by 2040; their national (*Environmental Protection and Biodiversity Conservation Act 1999*) and relevant state or territory status; and their location. Critically Endangered (CR), Endangered (EN), Vulnerable (VU), and Not listed (-). NB: Conservation statuses listed were current at the time that the study was undertaken and published.

Rank	Species	Extinction probability by 2040	National (EPBC) Status	State/Territory Status	State/Territory
1	Northern gastric-brooding frog, <i>Rheobatrachus vitellinus</i>	95% Likely extinct	EX	EN	QLD
2	Mountain mist frog, <i>Litoria nyakalensis</i>	94% Likely extinct	CR	CR	QLD
3	Yellow-spotted tree frog, <i>Litoria castanea</i>	93% Likely extinct	CR	CR/CR	NSW/ACT
4	Northern tinker frog, <i>Taudactylus rheophilus</i>	92% Likely extinct	EN	EN	QLD
5	Kroombit tinker frog, <i>Taudactylus pleione</i>	70%	CR	CR	QLD
6	Southern corroboree frog, <i>Pseudophryne corroboree</i>	66%	CR	CR	NSW
7	Baw Baw frog, <i>Philoria frosti</i>	65%	CR	CR	VIC
8	Armoured mist frog, <i>Litoria lorica</i>	57%	CR	CR	QLD
9	Mountain-top nursery frog, <i>Cophixalus monticola</i>	47%	CR	CR	QLD
10	Beautiful nursery frog, <i>Cophixalus concinnus</i>	45%	CR	CR	QLD
11	Northern corroboree frog, <i>Pseudophryne pengilleyi</i>	38%	CR	CR/CR	NSW/ACT
12	Spotted tree frog, <i>Litoria spenceri</i>	36%	EN	CR/CR	NSW/VIC
13	Kroombit tree frog, <i>Litoria kroombitensis</i>	31%	CR	CR	QLD
14	Mt Elliot nursery frog, <i>Cophixalus mcdonaldi</i>	29%	CR	CR	QLD
15	Kuranda tree frog, <i>Litoria myola</i>	29%	CR	CR	QLD
16	Eungella day frog, <i>Taudactylus eungellensis</i>	27%	EN	EN	QLD
17	Bellenden Ker nursery frog, <i>Cophixalus neglectus</i>	26%	CR	CR	QLD
18	Rattling nursery frog, <i>Cophixalus hosmeri</i>	20%	CR	CR	QLD
19	Tapping nursery frog, <i>Cophixalus aenigma</i>	16%	EN	NT	QLD
20	White-bellied frog, <i>Geocrinia alba</i>	15%	CR	CR	WA
21	Littlejohn's tree frog, <i>Litoria littlejohni</i>	12%	VU	VU/EN	NSW/VIC
22	Sloane's froglet, <i>Crinia sloanei</i>	10%	EN	VU	NSW
23	Richmond Range mountain frog, <i>Philoria richmondensis</i>	9%	-	EN	NSW
24	Howard River toadlet, <i>Uperoleia daviesae</i>	8%	-	VU	NT
25	Giant burrowing frog, <i>Heleioporus australiacus</i>	8%	VU	VU/CE	NSW/VIC
26	Mahony's toadlet, <i>Uperoleia mahonyi</i>	4%	EN	EN	NSW



LEFT: Dr Emily Hoffmann from the University of Western Australia undertaking research to benefit white-bellied frog conservation in Western Australia. Image: Emily Hoffmann

Research implications

Our findings are most important to decision-makers, funding bodies, state and federal government agencies, conservation land managers, and researchers looking to prioritise research and management actions for threatened Australian frogs.

Identifying the species at greatest risk of extinction is important to forewarn governments, conservation managers and the community about which species are most highly imperilled. This enables emergency care and recovery actions to be implemented, helping to prevent extinctions.

Some good action is already happening for these species; such as population supplementation work for southern corroboree frogs that has stopped the species from going extinct.

Fundamentally, urgent investment and more strategic conservation effort are required to avert the impending extinction of Australia's most imperilled frogs. Without new, targeted action, at least 8 species are likely to be lost to extinction by 2040.

Some extinctions may be averted using well-established approaches to threat management, such as feral animal control in key habitats. More knowledge and insights are

required through further research to determine the most effective ways of increasing resilience in these species, such as with chytridiomycosis. Climate change is more intractable, but solutions might include assisted colonisation of new habitats, or targeted and assisted gene flow among populations.

Given current trends, a contingency plan should be developed to ensure adequate monitoring, and to identify thresholds for action and planning for interventions that might be required, such as captive management and breeding programs of additional species beyond those already maintained successfully in captivity.

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Changed fire patterns are a threat to half (13) of the imperilled frog species. Image: Doug Becker CC BY SA 2.0 Flickr