

= Green and golden bell frog =

The green and golden bell frog ( *Litoria aurea* ), also named the green bell frog , green and golden swamp frog and green frog , is a ground dwelling tree frog native to eastern Australia . Despite its classification and climbing abilities , it does not live in trees and spends almost all of its time close to ground level . It can reach up to 11 cm ( 4 @. 5 in ) in length , making it one of Australia 's largest frogs .

Coloured gold and green , the frogs are voracious eaters of insects , but will also eat larger prey , such as worms and mice . Unlike most frogs , they are active at day , although this is mostly to warm in the sun . They tend to be less active in winter except in warmer or wetter periods , and breed in the warmer months . Males reach maturity after around 9 months , while for the larger females , this does not occur until they are two years old . The frogs can engage in cannibalism , and males frequently attack and injure one another if they infringe on one another 's space .

Many populations , particularly in the Sydney region , inhabit areas of infrequent disturbance , such as golf courses , disused industrial land , brick pits , and landfill areas . Though once one of the most common frogs in south @-@ east Australia , the green and golden bell frog has endured major population declines , particularly in highland areas , leading to its current classification as globally vulnerable . Its numbers have continued to fall and are threatened by habitat loss and degradation , pollution , introduced species , and parasites and pathogens , including the chytrid *Batrachochytrium dendrobatidis* . As most of the remaining populations live on private land , the logistics of the conservation effort can be complicated . Despite the situation in Australia , some frog populations have survived with more success in New Zealand and several other Pacific islands , where it has been introduced . However , unfortunately even in these areas the population of green and golden bell has been rapidly declining in the past few decades .

= = Taxonomy = =

The common name , " green and golden bell frog " , was first adopted by Harold Cogger in his 1975 book *Reptiles and Amphibians of Australia* . Before this , its common names were " golden frog " and " golden tree frog " . The green and golden bell frog has many physical and behavioural characteristics representative of ranids , hence its original classification as *Rana* . It has a pointy snout , long legs , and almost complete toe webbing ; the tympanum is large and distinct ; and the overall body shape is similar to many *Rana* species . Like many frogs in the *Rana* genus , green and golden bell frogs are mostly aquatic , and only travel over land during periods of rainfall . It was removed from the genus because of anatomical differences with the family *Ranidae* . The bone and cartilage structural formations of the green and golden bell frog are closest to those of species in the family *Hylidae* ; it was therefore reclassified .

The green and golden bell frog was first described as *Rana aurea* by Lesson in 1827 . It has changed classification 20 times ; it was first named *Litoria aurea* in 1844 by Günther , and changed another 9 times before being named again as *Litoria aurea* . The specific epithet *aurea* derived from the Latin *aureus* for ' golden ' . The species is now classified within the *Litoria aurea* complex , a closely related group of frogs in the *Litoria* genus . This complex is scattered throughout Australia : three species occur in south @-@ east Australia , one in northern Australia , and two in Southwest Australia . The complex consists of the green and golden bell frog ( *L. aurea* ) , growling grass frog ( *L. raniformis* ) , yellow @-@ spotted bell frog ( *L. castanea* ) , Dahl 's aquatic frog ( *L. dahlii* ) , spotted @-@ thighed frog ( *L. cyclorhyncha* ) and the motorbike frog ( *L. moorei* ) . The ranges of *L. raniformis* and *L. castanea* overlap with the green and golden bell frog ; this , as well as physical similarities , may make it difficult to distinguish between the species , and until 1972 , *L. raniformis* and the green and golden bell frog were regarded as the same , when electrophoretic studies proved them to be distinct . The tablelands bell frog has not been seen since 1980 and may now be extinct , although the large yellow spots present on its thighs help distinguish it from the green and golden bell frog . The growling grass frog , which is very similar to the green and golden bell frog , can only be readily distinguished by raised bumps on the dorsal surface . It has also been proposed

that some populations of *L. aurea* located near Ulong , New South Wales , be a separate subspecies , *L. a. ulongae* , but this was not accepted .

*Litoria aurea* is equally and most closely related to *L. castaneae* and *L. raniformis* . A microcomplement fixation technique using serum albumins has indicated the species closest to *L. aurea* is *L. raniformis* . Albumin immunological distance data suggest no differentiation between the two , and the green and golden bell frog evolutionally separated from the other two species about 1 @. @ 1 million years ago . A 1995 study of protein variations showed four of 19 protein systems had variation and only two had differentiation . Scientists believe the different species can still hybridise , as their distribution areas still overlap , and both *L. raniformis* and *L. aurea* have been seen sharing ponds in the Gippsland area of Victoria . However , little evidence of hybridisation actually occurring has been found . Although there have been reports of frogs of mixed appearance in Gippsland , analysis of proteins and sera of the frogs showed two distinct species . Samples in other area of distribution have shown no evidence of hybridisation in spite of cohabitation .

= = Distribution = =

The green and golden bell frog is native to south @-@ eastern Australia . Before its decline in population , its distribution ranged from Brunswick Heads , in northern New South Wales , to East Gippsland , in Victoria , and west to Bathurst , Tumut and the Australian Capital Territory .

The bell frog 's current distribution now ranges from Byron Bay , in northern New South Wales , to East Gippsland , in Victoria ; populations mostly occur along the coast . In New South Wales , it has declined severely in range and abundance since the 1960s , although no similar declines have been reported in Victoria . In New South Wales , it has disappeared from highland areas above 250 m ( 820 ft ) , except for a population in Captains Flat . A study of populations along coastal New South Wales indicated many populations were very small , usually of fewer than 20 adults . According to a 1996 study , six populations of more than 300 frogs are known : two in the Sydney metropolitan area , two in the Shoalhaven , and two in the New South Wales mid @-@ north coast . There are now approximately only 40 sites in total where it is found , most of which are in the Sydney area . The green and golden bell frog has disappeared from an estimated 90 % of its former range . Some specimens were apparently found in Armidale , but it turned out to be a misidentification of *L. castaneae* . The declines in Victoria have been more modest and mostly in at inland areas where habitats have disappeared .

The green and golden bell frog survives in some areas of Sydney , such as the Brickpit at Sydney Olympic Park ( the proposed site for the tennis courts for the 2000 Sydney Olympics ) . When the green and golden bell frog was found there , the tennis courts were built elsewhere , and the population has since been monitored . This frog has become an unofficial mascot for the Homebush Bay area . It has also been introduced to places in Sydney in its natural habitat , without much success .

The green and golden bell frog occurs on three islands off the east coast of Australia : Kooragang and Broughton Islands off Port Stephens , and Bowen Island at Jervis Bay . It was introduced to New Zealand in the 1860s , and it is now common on the part of North Island north of Rotorua . In most places , it is the only frog species in the vicinity . However , recent declines have been reported , suspected to be due to predatory fish . It was also introduced to the Pacific island countries of New Caledonia and Vanuatu in the 19th century , and has since become common there .

No discernible variation in size or appearance in green and golden bell frogs between different geographic areas is found . Fluctuations in size and appearance between different populations are outweighed by variations within the populations themselves . Females are more likely to be found away from breeding sites , while the opposite applies for males . Metamorphlings are divided in roughly equal numbers between males and females , while juvenile frogs are observed less often than their mature counterparts , although scientists are not sure whether this is due to lower abundance or increased reclusiveness .

= = Description = =

The green and golden bell frog is a large , stout frog ; adults range from 4 @. @ 5 to 11 cm ( 1 @. @ 8 to 4 @. @ 3 in ) in length ; typical specimens measure 6 to 8 cm ( 2 @. @ 5 to 3 in ) . The green and golden bell frog is therefore one of the largest Australian frogs . Mature males are generally smaller than mature females , and the colour on their dorsal surfaces differ greatly from females . It may be almost completely green , of shades from dark pea @-@ green to bright emerald , green with metallic , brassy , dull copper @-@ brown , or gold markings ; or almost completely bronze . Generally , females tend to have more green patches than males . During the cooler months ( May ? August ) , when the frogs are inactive , colouration may darken almost to black . They can also darken in this way by simply staying in a dark place for a few minutes , and the colour can also change during the frogs ' lifetimes .

A creamy @-@ white or pale yellow stripe , bordered above with gold and below with black , extends from behind the eye , across the typically copper @-@ coloured tympanum to the groin . This stripe rises to form a dorsolateral fold towards the groin . Another stripe of the same colour begins below the eye and continues to the shoulder . The abdomen is cream or white , and has a coarsely granular texture . The legs are green , bronze , or a combination of both , and the inside thigh and groin are blue @-@ green . Mature males develop a yellowish colouration to the vocal sacs on their throats . The tympanum is distinct and ovular in shape , and the species has enlarged toe discs to aid in climbing . As this species is often found in water , the fingers are free from webbing , while the toes are almost completely webbed . When in breeding condition , males develop nuptial pads on their thumbs , which are used to grip females during mating . These are coloured brown during the breeding season , but are inconspicuous and paler during the rest of the year . During the breeding season , females develop a blueish hue on their feet , while males ' legs turn rusty orange .

= = Ecology and behaviour = =

As a member of the tree frog family , the green and golden bell frog spends much time basking in the sun on vegetation , rocks , and reeds , usually near water , or hopping around between such places . Unlike most frog species , it is often active during the day . When handled , this species secretes a slimy acrid mucus , which consists of 17 aurein peptides . Thirteen of these show broad @-@ spectrum antibiotic and anticancer activity . The secretion makes the frog slippery and hard to grip , and is poisonous to some other species of frogs , so it is a useful defensive tool for green and golden bell frogs . Males often fight one another if they come within 1 m of each other , frequently leading to injuries .

The green and golden bell frog has been detected in a wide range of habitats . It is generally associated with coastal swamps , wetlands , marshes , dams , ditches , small rivers , woodlands , and forests , but populations have also been found at former industrial sites ( for instance , the Brickpit ) . It has even been found in human vessels such as bathtubs . The requirements of its habitat have been difficult to determine , for it has been found in a wide range of water bodies except fast @-@ flowing streams . It is most typically found in short @-@ lived freshwater ponds that are still , shallow , unshaded , and unpolluted , and it tends to avoid waters that contain predatory fish , whether native or introduced . However , it is most often found in areas that have been affected by human habitation . The frog prefers water bodies that support emergent vegetation , such as reeds and bullrushes , for basking , and winter habitats consist of available shelters around the breeding site , which can be vegetation , rocks , rubbish , or human debris and discarded building materials . Grassy habitats are usually close at hand to provide suitable terrestrial feeding grounds . It prefers waterways with a substrate of sand , rock , or clay , and can tolerate a wide range of water turbidities , pH and oxygen levels , and temperatures , although these can hamper physical growth . Although its legs provide much grip , the frog does not choose to climb trees or live up them to any significant extent . It spends most of its time within 10 cm of the ground and rarely ventures more than a metre above the ground . The green and golden bell frog also has the ability to sit still for several minutes .

The green and golden bell frog can travel far in a single day or night ; distances of 1 @. @ 0 to 1 @. @ 5 km have been recorded . Tagging experiments have shown that some can move up to 3 km in total , and that some travel several kilometres from the closest breeding habitat . However , the species evidently tends to return to or remain at an identified site , provided the habitat stays appropriate for its needs , or else it will move away . The green and golden bell frog also favours areas with the greatest habitat complexity , and as such , this is a core component of habitat @-@ based strategies to protect the species . In general , the frogs stay within areas of 100 ? 700 m<sup>2</sup> The frog is well equipped for survival on land . It can rehydrate by absorbing moisture through its ventral skin , and evaporative water loss occurs at a rate , indicative of a watertight skin. very low Some have been observed up to 400 m from the nearest body of water .

During the winter months , the frog tends to be inactive , staying in one place , whereas it moves around during the warmer months to search for food and mating partners . During winter , the frog does become active for brief periods during warm or wet weather . In cold conditions , the frogs are thought to hibernate , based on observations of some being uncovered in a " torpid " state , but this has yet to be proven with rigorous physiological studies . Although the frog is active during the day , this is restricted to leaving its shelter to sunbathe . It tends to not actively feed or forage during the day , hunting insects only if they move into its vicinity .

The green and golden bell frog 's reproduction depends on salinity and water temperature . Salinity affects tadpoles ' development and metamorphosis , and breeding is significantly slowed for ponds that measure 20 ° C ( 68 ° F ) or below . The tadpoles can tolerate salinity levels of six parts per thousand ( ppt ) without any apparent effects , while salinity of 8 ppt or higher decreases growth rates and increases mortality rates . On the other hand , salinity levels of at least 1 ? 2 ppt can be beneficial to the green and golden bell frog because this kills pathogens such as the chytrid fungus . The pH of the pond is not found to affect the likelihood of the eggs to hatch for values between 4 and 10 .

= = = Diet and predators = = =

The voracious adults have very broad diets , including insects such as crickets , larvae , mosquito wrigglers , dragonflies , earthworms , cockroaches , flies , and grasshoppers . They are also known to eat freshwater crayfish and slugs , and other frogs , even of the same species . They have a strong tendency for cannibalism , and frequently these in the same enclosure devour each other . Studies and trials in the wild have shown cannibalism also occurs in the wild .

The tadpoles feed on detritus , algae , and bacteria . Tadpoles in more advanced phases of development may show a preference for vegetable matter , but also scavenge or become carnivorous on aquatic life . Captive tadpoles have eaten boiled lettuce and pet food in pellet form . If population density is high , tadpoles have cannibalised one another .

In captivity the green and golden bell frog is known to feed on crickets , fruit flies , maggots , silkworms , domestic flies , beetles , mealworms , larvae , slaters , cockroaches , molluscs , plague locusts , spiders , water snails , earthworms , and mice . A case of a small tiger snake being eaten has also been reported . Captive frogs have a habit of not responding to stationary food items , which has helped to form the belief that the frog will eat most things that move .

The hunting habits of the frogs change depending on their growth phase and thus physical size . Smaller , still @-@ growing green and golden bell frogs tend to hunt small , especially flying , insects , often jumping to catch their prey . Adult frogs appear to show a distinct preference for larger , land @-@ based insects and frogs , although they also eat aquatic prey , such as tadpoles and other aquatic organisms . Recently metamorphosed individuals have also been seen enter to shallow water to capture mosquito wrigglers . The relative proportion that various prey make up in the frog 's diet is not known . In observed studies of captive frogs , they eat less in cooler periods of the year , and frogs in the wild ate less during breeding periods . Younger frogs were also seen to forage longer into the warmer months to build up food stocks than fully matured frogs .

Natural predators include wading birds , such as reef egrets , white @-@ faced herons , white ibises and swamp harriers . Other predators include snakes , skinks , red foxes , tortoises , and eels

and other fish , such as redfin perch and European carp , several varieties of gudgeon , and a range of invertebrate predators , such as the large brown mantis . Predation on adult frogs has been recorded for the red @-@ bellied black snake , tiger snake , laughing kookaburra , and sacred kingfisher ; wading birds and other snakes , such as the green tree snake and the copperhead snake , are also believed to be predators of the frog . The relative magnitude of the various predatorial threats to the frog and its tadpoles is not known . Before the frog became rare , and when subsistence lifestyles were more common , it was hunted and eaten by Australian Aborigines . It was also used in dissection demonstrations in biology classes , and caught by humans for feeding pet reptiles .

### = = = Reproduction = = =

The green and golden bell frog breeds in the warmer months from October to March , although some cases have been recorded earlier at the end of winter . Reproduction appears to be influenced by geography . More southerly and highland populations appear to have a shorter window for breeding than their more northerly and lowland counterparts . The latter appear commence breeding earlier and end later than the former group . During the breeding season , males call , usually while floating in the water , but sometimes on vegetation at the side of a pond , mainly at night . They do so with a deep growl that has been described as a four @-@ part " walk @-@ walk sound " ? likened to the sound of a motorbike changing gears . Males have been found to respond to recordings of the call , and this is why entire groups of males will then call in unison . Males are also more likely to call under certain temperature ranges , 16 ? 23 ° C for water temperature , and 14 ? 25 ° C in the air . Calling is also more likely immediately after rain has occurred .

Males appear to reach maturity at around 45 ? 50 mm , at between 9 and 12 months , and at this size begin to develop a grey to brownish yellow wash beneath the chin . This indicates the development of a vocal sac and thus an ability to commence calling behaviour . Females reach sexual maturity at two years ; those smaller than 65 mm are not seen in amplexus ; this length is not reached until the second season after metamorphosis . The frog is not of a type that only breeds once . Females can shed up to 26 % of their weight when spawning , while males have also been seen to lose weight during breeding , because they are eating less . The weight lost during the breeding season is typically regained from January to September .

Amplexus between the male and female occurs mainly in water , but sometimes at substantial distances away on dry land . Observations of breeding sites have shown the males linger around the courting area for much longer times , while females mostly stay at other places to find food before meeting the males there . During amplexus , the males grab the females near their armpits after climbing on their backs . In the wild , amplexus usually takes between 10 minutes and five days . Artificially induced amplexus in the laboratory has been observed to last 50 hours , but there have been reports of five days . Sometimes , amplexus will not result in eggs being laid .

The frogs may move up to 100 m during amplexus before the female lays her eggs . During the laying of the eggs , the pair of frogs remain in amplexus and the male is assumed to fertilise the eggs with his sperm . Males are also seen to paddle their rear legs during this time , which is speculated to accelerate fertilisation . The egg @-@ laying and fertilisation process takes around five minutes . An average of 5 @,@ 000 eggs are deposited amongst aquatic vegetation in a gelatinous mass ; however , a clump of 11 @,@ 682 has been recorded . The female moves around while depositing , leaving a trail of eggs that sometimes entangles upon itself . Initially , the mass floats , but sinks up to 12 hours after laying , or when disturbed . The eggs are distinct from those of other frog species ; they are 2 ? 2 @.@ 5 mm wide upon deposition and are bicoloured , black at one end and white at the other . They immediately begin to expand , quickly reaching around 4 mm across , before sinking . When first laid , they float with the black pointing up , but after sinking , the orientation becomes disordered . Two to five days later , the tadpoles hatch out , but the process can take only a few hours on occasions . The hatching rate varies between 46 and 77 % , and peaks at 22 ° C. Hatching is less likely in acidic waters , although alkaline conditions do not lead to a lower rate compared to neutral conditions . Given the large number of eggs that hatch per female

and given the scarcity of mature frogs , tadpole survival rates are believed to be very low .

Upon hatching , the tadpoles are around 2 @. @ 5 ? 3 mm in snout @-@ vent length ( SVL ) and about 5 ? 6 mm including the tail . Tadpoles in captivity increase exponentially over time in total length ; their SVL increases from about 3 to about 9 mm within five weeks , and it triples again in the next five weeks . In all , the growth rate is 0 @. @ 2 mm per day in the first five weeks . The tadpoles of the green and golden bell frog are large , reaching 80 mm ( 3 @. @ 1 in ) in length , but size varies greatly and most are much shorter . The body is usually as wide across as it is deep . The fin has a yellow tinge and is considerably arched . The musculature is moderate and tapers to a fine point , as does the fin . The body wall is translucent yellow with darker areas over the abdomen . Just before its limbs form , the tadpole begins to develop the greenish colouration of the adult . Tadpoles usually swim within 30 cm of the water surface , or remain stationary at the bottom . They often move together in groups akin to schools of fish .

Towards the end of the tadpole phase , hind legs appear , followed by front limbs , and the phase ends when the front limbs are developed . This normally occurs between October and April due to the breeding season , but tadpoles been observed in the wild throughout the year , suggesting some tadpoles overwinter ; this has been seen to occur for captive tadpoles . The length of the tadpole stage , in the wild and in captivity , is usually between 10 and 12 weeks , but can range from five weeks to a year . The slower @-@ growing tadpoles usually progress during winter , as there is a positive correlation between growth rates and temperatures . Variation in growth rate across pH values of 4 , 7 and 9 was insignificant . In the first four weeks , there was no significant dependence of the growth rate across the 18 ? 26 ° C range , but from this point on , growth was significantly hindered at 18 ° C. At the beginning of the metamorphing stage , all limbs are present and developed , along with a tail . During this phase , the tail is resorbed , and the only other visible change is the spiracle closing . Metamorphing tadpoles typically have a SVL of 22 ? 28 mm , and will complete metamorphosis between two and 11 months , depending on the temperature of the water and available food . The process is slowed at low temperatures , but generally takes between three and eight days after the tadpole stage is complete . Breeding occurs in a significantly higher proportion of sites where no predatory fish are present , and water bodies are ephemeral rather than permanent . Populations in Victoria , however , have been recorded as breeding in permanent ponds as readily as they do in ephemeral ponds .

Metamorphs resemble the adults and average about 2 @. @ 6 cm ( 1 @. @ 0 in ) in length . Recently metamorphosed frogs have been observed to rapidly leave the breeding site , especially when foraging habitat is nearby , and less so if food is not available away from the area . The tendency to migrate is often attributed to cannibalism practised by larger frogs on those that are still developing . After metamorphosis is complete , the frog is around the same length . The juveniles initially grow rapidly , reaching 45 mm within two months , 50 ? 60 mm within half a year , before growth slows. months , and increase in length more slowly after that . Once sexual maturity is reached , the frogs ' physical growth is very slow .

Metamorphs weigh about 2 g , while the largest adults can reach 50 g . Individual frogs can vary substantially in body weight due to changes in the amount of stored fat , recent eating , and egg formation . While it is known to live 10 ? 15 years in captivity , the frog 's lifespan in the wild is not well understood .

= = Conservation status = =

The numbers of green and golden bell frogs are estimated to have declined by more than 30 % in the past 10 years . It is listed as globally and nationally vulnerable , and as endangered under the New South Wales Threatened Species Conservation Act , 1995 . Although it is only classified as vulnerable at national level , the National Frog Action Plan classifies the green and golden bell frog as endangered . In contrast to Australia , the frogs are abundant in New Zealand and classified as feral and unprotected .

Many factors are thought to be responsible for the dramatic decline of this species in Australia , including habitat fragmentation , erosion and sedimentation of soil , insecticides and fertilisers

contaminating water systems , the introduction of predatory fish , and alteration of drainage regimes . Population declines are closely related to the introduction of the eastern mosquitofish ( *Gambusia holbrooki* ) , a species native to North America that was introduced to control mosquito larvae . Laboratory studies have demonstrated the eggs and tadpoles of the green and golden bell frog are extremely susceptible to predation by this fish , and in 77 of the 93 sites in New South Wales where the green and golden bell frog was known to have disappeared before 1990 , eastern mosquitofish were found to be present . The frogs have been known to inhabit waters containing the fish , but breeding is rarely successful there , pointing to the fish 's voracious eating of eggs and tadpoles . The fish are not yet present in eastern Victoria , where green and golden bell frog numbers have remained solid , but the fish likely will spread to rivers there , possibly inflicting heavy losses on the frogs .

Other factors thought to affect this species include predation by introduced mammals , such as cats and foxes , changes to water quality at breeding sites , herbicide use , and loss of habitat through the destruction of wetlands . The amphibian chytrid fungus appears to have led to at least some of the decline in numbers , but the relative importance of the various factors is unclear . The frogs may have become more susceptible to chytrid rather than the fungus being more common . The genetic pool of the frogs has been found to be relatively small , attributed to habitat destruction , which has confined the smaller groups of frogs to isolated pockets and increased the incidence of inbreeding . This has led to proposals for frog populations to be mixed by human intervention in an attempt to reduce negative genetic effects and boost survival rates .

The cannibalism of the frog has been speculated to cause its decline in some areas , because the smaller tadpoles can be toxic . Other postulated causes of the decline include increased ultraviolet radiation due to the hole in the ozone layer , global warming , and increased drought . The first theory was tested and the results were inconclusive . Global warming is not thought to be a credible cause , as the extremities of the frog 's range have not changed , while declines in population have occurred in both dry and wetter areas .

The green and golden bell frog has been the subject of much research and monitoring , important to improving its conservation . Research focuses on the development of management measures to keep the introduced mosquitofish under control . These include poisoning the fish , but the waterways are large and trials have given mixed results . Predators of the mosquitofish have also been tried . Other strategies may allow for the development and improvement of suitable habitat , and to increase the reproductive success of the species . Parallel to these measures , community awareness programmes have also been proposed . One difficulty in protecting the frog is that only 20 % of the known populations in New South Wales since 1990 occur in conservation parks . Of the eight populations that occur in conservation parks , only five are wholly located within them and one of these is not breeding . There have been calls for legislation to be introduced to stop habitat degradation on private land to prevent detrimental effects to the frogs . Many proposed developments have been subjected to legal action to protect the habitat , and some communities have started " Friends of the Green and Golden Bell Frog " action groups . As public awareness has increased , documentary and news segments on the deteriorating situation have become more frequent and references to the frog in environmental logos and artworks have increased . The effort to increase public consciousness of the green and golden bell frog has also been aided because its colours are the same as the national colours . Restrictions on logging close to areas inhabited by the frogs have been put in place . As green and golden bell frogs are mostly observed in environments disturbed by humans , targeted environmental interference is seen as a possible means of enhancing habitats .

In 1998 , a captive @-@ breeding program was set up by the herpetofauna staff at Taronga Zoo in Sydney , sponsored by the ASX Frog Focus . The purpose of the program was to help preserve declining populations of green and golden bell frogs in the Sydney region . It involved the captive breeding of wild frogs and releasing large numbers of tadpoles back into the wild , habitat restoration , and monitoring after releases . The program was initially titled " Frog Focus Botany " , as Botany was the original focus site . Thousands of tadpoles were released into a site in Sir Joseph Banks Reserve and postrelease monitoring was done by the local community . It was also the first

time that school students had been involved with endangered species monitoring . The program has since branched off into several other areas . Between 1998 and 2004 , tadpoles were released into specially designed ponds and dams on Long Reef Golf Course at Collaroy in northern Sydney , with little success . Although green and golden bell frogs had previously been located in the area , the population had since been lost . Mature male bell frogs are occasionally found there ; however , a permanent breeding population has yet to be established . An attempted reintroduction at Marrickville in inner @-@ Sydney has failed due to chytridiomycosis .