The Study on the Characteristics of Ecological Wetland Parks Which Are Suitable for Frog Habitat
–The Example of the Landscape Design of Melbourne Galada Avenue Reserve

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Abstract. Global species diversity continues to decline and organizations such as the United Nations have signed several biodiversity contracts to protect and enhance species diversity. The enrichment of species diversity can maintain or enhance stability, sustainability and functionality of ecosystems. Frogs are the most abundant and environmentally sensitive amphibians, and are used as an important indicator of regional and global ecological performance, so it is important to increase the diversity and number of frog species. The current research on frog ecological park design characteristics needs to be further deepened and a relatively comprehensive summary is needed. Through the analysis of frog habitat preference, biological research, wetland park design and other related literature, this study conclude that the characteristics of ecological wetland parks suitable for frog habitat should have a moderate scale, coherent habitat, reasonable traffic roads, a diverse waterfront, suitable waterfront slope and pool depth, stable water source, low salinity, low pollution water quality and suitable plant mix for frog survival. Taking the species enhancement of endangered species of Growling Grass Frog in Melbourne, Australia, as an example, the landscape design of Galada Avenue Reserve is suitable for the habitat of this species, specifically giving the design to meet foraging, activity, protection and the breeding conditions of this species, forming a special ecological wetland park suitable for the survival activities of this species. It will create a suitable habitat for the roaring grass frog, and protect and gradually restore the population of the species to a balanced state. The reserve will serve as a model for local endangered amphibian conservation parks and a reference for other regional frog conservation parks and ecosystem strengthening through species diversity enhancement.

Keywords: Ecological wetland park · Landscape design · Growling Grass Frogs · Biodiversity · Aquatic ecosystem

1 Introduction

Biodiversity is defined as "the sum of all genes, biological species, their genetic variation and the complexity of ecosystems at a given time and in a given area" [1]. The United Nations has designated 2010 as "The International Year of Biodiversity" (IYB), with the

R. Lotfi et al. (Eds.): UPRE 2023, AEBMR 253, pp. 409–420, 2023.
https://doi.org/10.2991/978-94-6463-218-7_46

slogan "Biodiversity is life. Biodiversity is our life." expresses that the conservation of biodiversity is the basis for the survival and development of human society. Biodiversity is our life. With the development of social research, many species have been found to play an important role in the medical and scientific fields. In 1992, the United Nations (UN) signed the Convention on Biological Diversity at the World Conference on Environment and Development in Rio de Janeiro, Brazil, to ensure that as the world continues to develop, it will still have enough biological resources to sustain life on Earth. The Convention on Biological Diversity was signed at the 1992 World Conference on Environment and Development in Rio de Janeiro, Brazil, to ensure that as the world evolves, it will continue to have enough diverse biological resources to sustain life on Earth and to find ways to conserve biodiversity across [2].

Amphibians have a dual living environment and are sensitive to the environment. The diversity and number of species reflect the quality of the ecological environment and are used as important indicator groups for ecological monitoring. The population size of frogs can reflect the combined effect of various factors in the natural ecosystem and is a weather vane of the environment in the area where the population lives and even globally, because their juvenile and adult forms are different. The increase of frog population and species diversity indicates the improvement of ecology. Therefore, it is crucial to establish ecological wetland parks suitable for frog habitats.

2 Characteristics that Should Be Present in a Frog Wetland Park

Through the analysis of frog habitat preferences, biological studies, wetland park design and other related literature, we summarized the characteristics required for an ecological park suitable for frog habitat with respect to habitat, water characteristics, water quality and plant mix.

2.1 Habitat

(1) With a certain scale

According to island and geography theory, compared with small habitat patches, large habitat patches usually contain larger populations, more complex biological relationships, higher ecosystem stability, easier to resist changes in the external environment, less likely to be destroyed, and a lower probability of species extinction. And one large protected area is better than several small protected areas with the same total area. Wetland parks in cities should have an area of at least 1 hectare, and should be divided into as large an area as possible according to the city's plan. A park area of 2 hectares or more and a wetland area of at least 50% of the park area is recommended to ensure the habitat needs of aquatic and amphibian species.

(2) Coherence

C.C. Vos and J.P. Chardon studied the effects of habitat fragmentation on frog distribution patterns and found that signs of habitat fragmentation reflect, to some extent, the distribution patterns of undesirable frog species [3]. Similar scientific findings are presented in the Nov. 30 issue of the American journal Science. Brazilian scientists conducted

experiments in a typical area of southern Brazil with high biodiversity and more than 480 species of amphibians and found that habitat fragmentation leads to a significant increase in the difficulty of exchanging adult amphibian habitats in breeding waters. The results indicate that habitat fragmentation can lead to rapid population extinction within one or two generations [4]. The results of this study indicate that habitat fragmentation can lead to rapid population extinction within one or two generations. Therefore, the close connection of water and land areas can ensure the dual needs of amphibians for water and land, allowing the species to reproduce.

(3) Reasonable traffic roads

Road construction in the wetland reserve has a significant negative impact on the overall structural damage to the wetland ecosystem. Through field surveys and field monitoring within the Merri Creek corridor, a re-analysis of the species' habitat association, consolidation of records, and use of more rigorous statistical methods, the analysis determined that the presence of more than 1000 m of traffic roads on the site negatively impacted frog habitat [5]. The analysis determined that the presence of more than 1,000 m of traffic roads on the site could negatively impact frog habitat. The most significant damage to the overall structure of the ecosystem is caused by the permanent blockage. The fragmentation of the wetland habitat into isolated areas causes changes in the direction of surface and groundwater flow, changes in the distribution of plant communities, and makes it impossible for amphibians to cross wide roads, thus making foraging and courtship more difficult. The reduction in the range of species' activities will easily lead to the reduction of population, weak resistance to diseases, inability to feed normally, lay eggs, and failure of larvae to develop, etc.

On the other hand, traffic noise and light pollution can damage the normal breath and reproduction of wetland organisms. Most of the wetland animals are diurnal, and the night lights of vehicles will affect their vision, so that their activities are disturbed or harmed [5]. Therefore, in large wetland reserves, road construction should be reduced to reduce the damage to the habitat and control the peers of vehicles at night; small wetland parks should also avoid overly wide roads to divide the wetland area, and rational planning of roads to reduce the impact of human behavior on species.

2.2 Water Characteristics

(1) Diverse waterfronts

The large number of rocks piled up along the water's shoreline provides space for frogs to bask and take shelter. Frogs are sensitive to temperature and depend on sunlight to regulate their internal temperature, which has the ability to promote growth. Tadpoles often bask at temperatures above 30 °C, and the optimal growth temperature for tadpoles is above 22 °C. At low temperatures, this species reduces foraging to reduce body consumption, which negatively affects the metamorphosis process of growth and development [6]. Rocks nearby and at the edges of wetlands help control the effects of water fungi by providing basking and warming shallow water and provide important shelter for winter frogs. It has been observed that on land, frogs most often inhabit bare soil, exposed rocks or leaf litter, while in aquatic environments they most often inhabit floating, submerged and submerged vegetation. Therefore, by the same token, the planting

of dense emergent and floating vegetation at the edges of wetlands is also an important space for frogs to provide thermoregulation.

Open water areas are provided at both ends of the park, with a gentle slope into the water and a relatively still water surface. The gentle slope is designed to allow vegetation to grow, creating a wetland edge with a high density of vegetation cover. Summer and fall are the main seasons when frogs engage in foraging activities. Some experiments have demonstrated that tadpoles are omnivores after sampling frog stomach contents for analysis, and that the algae at the wetland edge provide some nutrition and reduce the chance of tadpole predation. Adult frogs are considered to be carnivores, eating mainly invertebrates such as insects, insect larvae, woodlice, snails, spiders and worms, and small vertebrates. They are usually locate at or near the draught line on land in ambush, identifying and capturing prey by scent [7]. Submerged emergent plants provide effective cover and increase the chances of successful predation.

The water in the middle of the park, which connects the two ends of the open water, has a curved shoreline that reduces the velocity of the water. Frogs prefer relatively still or slow-moving waters, and from September to January, when male grass frogs are courting and breeding, still or very slow-moving waters are essential breeding habitat for this species. Therefore, a curved waterfront design can slow down the flow of water and provide suitable habitat for frogs.

(2) The appropriate water bank slope and pool depth

Wetlands should be located in landscapes with low anthropogenic disturbance, with shallow slopes of less than 3:1, allowing for plant growth at the wetland edge; waters less than 2.5 m deep longitudinally, limiting fish survival [8]. Under this water design condition, frogs can be helped to avoid predators, thus limiting the negative impact formed by predators on frogs.

The most common predators of tadpoles include beetles, birds, fish and dragonfly larvae. In a survey of celestial and artificial ponds in the southern highlands of New South Wales, fish were found to influence tadpole community composition and reduce tadpole species richness, and adult frog spawning site selection was shown to be influenced by predators and competitors in the water column. Vegetation abundance has also been shown to be important in helping tadpoles avoid predators [9]. The University of Michigan conducted experiments in bull drinking tanks to study predation among aquatic animals and concluded that the presence of large bullfrogs can negatively affect frogs and tadpoles. Access to temporary natural wetlands by bullfrogs should be avoided, reducing the chance that other amphibians will suffer increased predation, competition, and pathogen exposure as a result [10]. Researchers surveyed 49 artificial wetlands in northern Missouri and analyzed them for wildlife use in a wetland landscape where steep slopes, low vegetation cover, and permanent hydrologic cycles allow bullfrogs and stocked fish to persist, making them unsuitable for amphibian survival.

Therefore, it is jointly concluded from the above experiments that the wetland should adopt a shallow design to provide conditions for the growth of marginal plants, which can effectively protect tadpoles and provide foraging sites for adult frogs; control the water depth to limit fish survival and reduce tadpole predation.

(3) A stable water source

It has been shown that frogs prefer well-watered habitats and that droughts can lead to a significant decline in the species' population. Analysis has shown that water persistence and connectivity are positively correlated with the number of frogs living in the area, and that wetlands should be kept well-watered for at least six months of the year. The breeding season, especially between September and December, is a critical time when large amounts of water are needed [11].

Diverting or creating drainage lines to capture surface runoff, increasing water flow through diversion structures or pumping from nearby creeks or rivers, tapping into groundwater supplies, and capturing rainwater. Increasing water storage capacity by increasing the size and depth of wetlands, installing dikes or increasing the height of dikes, and capping or filling an existing drainage infrastructure can all help reduce water runoff [12]. The park should be constructed to ensure that three-quarters of the wetland area should be permanent or nearly so.

2.3 Water Quality

(1) Low salinity

Low salinity water is necessary for the survival of frogs. According to a survey conducted by Australian frogs, experimental analysis found that salinity negatively affects larval growth, metamorphosis and survival. Increased salinity of river water leads to stunted growth, reduced metamorphosis and increased tadpole mortality. Tolerable salinity of tadpoles is 4% sw, and when the salinity threshold reaches 5.5%–10% sw, it significantly reduces growth rate and can lead to mortality. Therefore, frog habitats should avoid sites affected by salinization and ensure that water salinity is below 7.0 mS/cm [13]. The salinity of water should be below 7.0 mS/cm.

(2) Pure and low-pollution water

Frogs depend on pure, low-pollution water as their habitat. If water ecosystems receive pollutants from urban and agricultural sources over time, nitrate concentrations gradually increase. Data from theater studies indicate that high doses of agrochemicals are typically directly lethal to amphibians, and sublethal concentrations can also lead to changes in reproduction, immune response, physiology, morphology, and behavior. Amphibians are particularly sensitive to nitrate produced with contaminants, with exposure resulting in a 79% reduction in activity, 29% reduction in growth, and 62% reduction in survival [14]. The use of vegetated buffer strips near waterways can reduce nitrogen pollution in surface waters. Also, reducing runoff, sewage discharge and fertilizer use, and developing and enforcing nitrate water quality guidelines can help improve water quality and provide safe habitat for aquatic organisms [15].

2.4 The Plant Matching

(1) Habitat preference of frogs

Wetland edges should have high densities of emergent, submerged and floating plants. According to several experimental surveys, frogs prefer habitats with high plant richness.

The proportion of vegetation at the wetland edge had the greatest positive effect on the number of frog species and the probability of individual occurrence, followed by the proportion of submerged and floating vegetation. In addition, the increase in the area of pond marsh vegetation had a positive effect on population size.

Adult frogs are agile, good climbers, and active both day and night, often feeding and basking in floating plants during the day [16]. They are also active during the day, often feeding and basking in floating vegetation. Flooded emergent vegetation is an important habitat for the successful breeding of frogs. They provide sites for the male calling stage and for the frog to lay eggs [17]. The average female lays about 3400–4500 eggs in a floating jelly raft before breaking and sinking [18].

In 2–4 days frog eggs will hatch into tadpoles and then undergo metamorphosis from the tadpole stage to adulthood, a process that usually takes 3–12 months. During this time, they are subject to predation by predatory fish and carnivorous insects. Among them, the highly invasive mosquito-eating fish (Gambusia Affini) is one of the most important reasons for the dramatic decline in the frog population [19]. During the long process, emergent and submerged plants in the pool form their refuge, reducing their chances of being predated by other species and increasing their chances of growing safely.

(2) Habitat preferences of species associated with food web

Adult frogs are carnivorous, feeding mainly on terrestrial invertebrates, including dragonflies, butterflies, moths, and sometimes other frogs, lizards, snakes, and small fish [20]. They usually wait for their prey to enter the feeding range rather than actively seeking food (Fig. 1).

Dense vegetation attracts large numbers of insects and helps frogs to hide themselves and increase the probability of predation. In the case of dragonflies, for example, the large

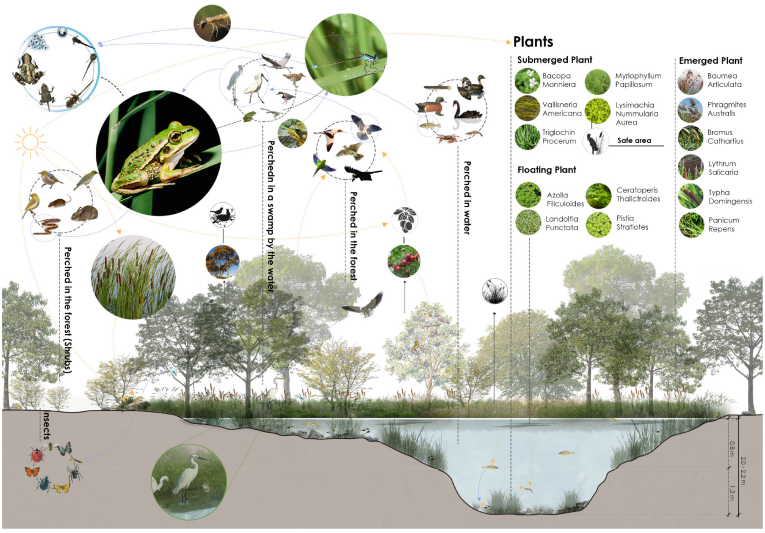

Fig. 1. The aquatic system food web

number of insects attracted by emergent plants is important prey for damselflies, and the colorful flowers and leaves and stems of the plants can serve as important habitats for attracting dragonflies to gather and provide resting and hiding places for adult blue-tailed damselflies to feed and breed. When female damselflies lay eggs, the male damselflies do not participate, but protect the newly mated females, and the emergent plants can serve as a shelter for them. They also tend to rest on the stems when the larvae hatch [21]. A large number of insects are active in spring and summer, flying from April to October, overlapping with the frog's heavy activity season. Planting emergent plants that attract abundant insects creates the conditions for adult frogs to grow and is an important place for this species to feed [22].

Tadpoles are omnivorous animals that feed on algae by scraping the algae with rows of horny teeth at the mouth. During the tadpole stage, this species is weak and less active, and its main plant food is water plants rich in vitamins and fiber, including algae, young shoots and fallen leaves; its animal food includes plankton, tsetse, dead animals, earthworms and water fleas. Planting abundant algae, floating plants and submerged plants can provide tadpoles with necessary plant food sources.

3 Galada Avenue Reserve Design, Victoria, Melbourne, Australia

Based on the decline of Melbourne's Victorian frog population, an ecological wetland park will be designed and rebuilt in Melbourne's largest city center park, suitable for the local endangered frogs, in order to restore the frog population and stabilize the local ecosystem.

3.1 Background

In the early 19th century, with the settlement of large numbers of foreigners and urban development, Australia's landscape changed dramatically, with widespread degradation of aquatic and terrestrial systems. Australia's forest cover declined by about 38%; sewage discharge, altered hydrological systems and pesticide use led to increased salinity and reduced water quality [23]. Amphibians have delicate skin and readily absorb toxins from the environment; have few defenses and are vulnerable to prey from non-native predators; are dependent on aquatic and terrestrial habitats at different times of their life cycle and are indicator animals of environmental health. With approximately 88% of extant amphibian species, frogs are the most common amphibian and exhibit the highest level of endemism among Australia's major animal groups, with the magnitude of landscape change across Australia reflected in the considerable number of frog species. Frog populations have declined substantially with habitat loss, and 208 species are now listed in the Australian Frog Action Plan [24]. Of these, the native Australian growling grass frog is native to southeastern Australia and lives in the swampy woodlands and scrub of South Wales, Victoria, Tasmania and South Australia [25]. A widespread and common frog, habitat fragmentation has led to a dramatic decline in the population and range of this species since about 1990, and it has even disappeared from some areas. The growling grass frog was listed as a threatened species under the Victorian Flora and Fauna Conservation Act of 1988 in 2001 and declared endangered in 2002 [26]. The growling

grass frog was declared endangered in 2002. In this case, a wetland park suitable for the growling grass frog will be recreated through the design of the Australian landscape, in response to the Convention on Biodiversity Conservation proposed by international organizations and the Australian government's protection of amphibians.

3.2 Location and Characteristics of the Site

Moonee Ponds Creek is a creek formed by puddles of water that swell during heavy rains, first flowing through what is now Melbourne's northwestern suburbs. Water quality and flow are rated as poor because of upstream flood control and stormwater runoff into the lower reaches of the creek, and residual pollution left in the streambed by industry along the river [27]. The Australian government has now adopted a restoration plan for the creek. A variety of different planting types are advocated in the creek corridor and in the form of patches to achieve the principle of providing larger and more diverse habitats throughout the corridor; a minimum 30 m vegetated buffer zone connected to the creek is supported to retain and protect important vegetation and increase the width of the corridor designed to protect biodiversity features. Emphasis is also placed on protecting natural drainage lines, retaining and using stormwater to enhance biodiversity, making the most of urban turnover, and using temporary or neglected spaces to enhance environmental benefits.

Galada Avenue Reserve was selected as the site for the construction of a frog theme park. Located in Victoria, adjacent to Parkville's Royal Park area, the park is integrated into the community and is part of the Moonee Ponds Creek system. It is Melbourne's largest downtown park, combining grass, native gardens and an open space with sporting facilities. Surrounded by no major factories or traffic arteries, which is suitable for Melbourne's animal sanctuary, the water management system associated with Moonee Creek ponds and the local urban habitat.

3.3 Galada Avenue Reserve Landscape Design

Galada Avenue Reserve was landscaped and reconstructed as a frog conservation wetland park to create the most suitable habitat for the growling grass frog to enhance the biodiversity of the species in the area and create a more stable ecosystem (Fig. 2).

(1) Functional partitioning

The park is mainly divided into frog conservation areas, providing visitors with an area to observe frogs and conduct educational science. The southern part of the park is mainly a residential area, which is quieter and used for frog conservation and recreation for visitors. Visitors can gather on the lawn for picnics and recreational sports activities. The larger area to the north will be fitted with science panels and model installations; incorporate planting experiences, outdoor lectures and other activities; and set up frog viewing points.

(2) Transportation planning

Ecological corridors are used as pedestrian trails in order to avoid noise and exhaust pollution from traffic roads that would affect the ecological environment of the park

Fig. 2. Master plan of Galada Avenue Reserve

and be detrimental to the survival of frogs. The design of the circular trail ensures the continuity of habitat and allows for a single route for human activities. The interior of the trails are protected areas for frogs, thus allowing frogs to move freely in the water and on land, avoiding human access to the area and thus disturbing the frogs. The use of permeable concrete paving allows for the collection of rainwater for filtration and watering of the park's interior plants, as well as providing sufficient water to increase the flow of water for frogs during the dry season.

(3) Water generation

To avoid habitat fragmentation that makes it more difficult for frogs to move between the terrestrial habitat and the water, the park waters will use a shallow pool with a slope at the edge of the pool and plant an appropriate amount of aquatic plants as a transition area to link the water and the land closely together. The slope of the pool is about 3:1 and the total depth is controlled between 2–2.5 m to limit the survival of fish and bullfrogs and to reduce the infestation of frogs and tadpoles in the water.

The open water design of the pond provides a large area of still water for the frogs, allowing floating and submerged plants to grow for the frog. The gentle slope in the middle of the park uses a curved waterfront design to link the open water at both ends, and the curved and thin structure slows down the flow of water, making it suitable for growling grass frogs. The abundant water supply provides an important place for frog activity and breeding in the fall. The exposed soil and large number of rocks at the edge of the wetland provide a place for the frog to bask in the sun for thermoregulation.

(4) The plant matching

Plant "filtering" vegetation in waterways, water edges and green belt areas to create a buffer and reduce nitrogen pollution in surface water. Regularly monitor water for

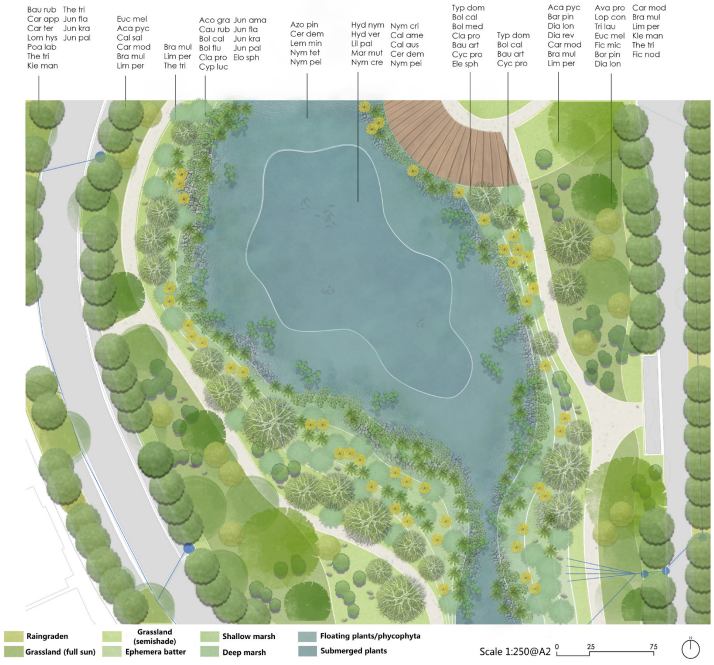

Fig. 3. The plant configuration of Galada Avenue Reserve

nitrates and other pollutants to provide pure, low-salinity water for the frog, allowing the species to develop and grow properly.

The wetland edges are planted using high cover amounts of aquatic vegetation. Submerged emergent plants serve as a refuge to reduce the chance of frogs being predated by egrets and snakes, and as a breeding site to provide a safe place for the spawned tadpoles to grow. In addition, the emergent plants at the edge of the wetland serve as an important feeding ground for growling and are selected to attract a large number of insects. Submerged plants planted at the bottom of the pool, floating plants and algae on the water surface can likewise serve as shelters for tadpoles, helping them to hide from fish predation, and providing plant-based food for tadpoles (Fig. 3).

4 Conclusion

Through habitat analysis, biological research and experimental data analysis, we summarize the characteristics of ecological wetland parks suitable for frogs, and create ecological space for endangered species by landscape design to enhance species population and species richness. Taking the redevelopment of Galada Avenue Reserve into an ecological wetland park suitable for the local endangered species of growling grass frog as an example, the habitat changes enhance the survival space of the species, showing that the landscape design for the habitat characteristics of the species plays an important role in maintaining and enhancing the ecosystem, which can effectively enhance the

number of the species and protect and gradually restore the population of the species to a balanced state. This study and the design concept can be used as a basis for the development of a new landscape. The study form and design concept can serve as a model for local endangered amphibian conservation parks and a reference for other regional frog conservation parks and ecosystem enhancement through species diversity.

It is worth mentioning that amphibians such as salamanders and giant salamanders can also be important indicator taxa for ecological monitoring and need to be protected. According to statistics, there are more than 6,000 species of frogs worldwide, and different families of frogs such as tree frogs, rain frogs, and toads have different habits. Some species are adapted to live underground or in trees; others lay eggs on land or bypass the tadpole stage; there are omnivorous species and a few species that feed on plants. The growling grass frog, as a more typical aquatic frog species in Australia, is not representative of other geographic areas and other types of species. This study only shows an example of landscape design for this species. The differences in habitat requirements between other geographic areas and different types of species need to be further studied and suitable conservation parks created according to specific needs.

References

1. Tor-Björn Larsson Biodiversity evaluation tools for European forests. Wiley-Blackwell, 2001. Retrieved 28 June 2011: pp. 178.
2. "Convention on Biological Diversity". Convention on Biological Diversity. Retrieved 24 July 2022.
3. C.C. Vos, J.P. Chardon. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog Rana arvalis. 05 January 2002. pp. 44–56
4. Paulo Inacio Prado. Science. Carlos Guilherme Becker, 2007. vol. 318. no. 5857: pp. 1775 - 1777 .
5. Geoffrey Heard, Peter Robertson, Michael Scroggie. The ecology and conservation status of the growling grass frog (Litoria raniformis) within the Merri Creek Corridor. Department of Sustainability and Environment, Flora and Fauna Branch, March 2004: pp. 1–33.
6. Robert Kenneth Browne, anielle Lisa Edwards. The effect of temperature on the growth and development of the endangered green and golden bell frog (Litoria aurea). Journal of Thermal Biology. Volume 28, Issue 4, May 2003: pp. 295–299.
7. Meghan R. Bishop; Robert C. Drewes; Vance T. Vredenburg. Herpetological conservation in North America | March 01 2014, Food Web Linkages Demonstrate Importance of Terrestrial Prey for the Threatened California Red-Legged Frog. Journal of Herpetology, 2014, 48 (1): pp. 137–143.
8. Christopher D. Shulse & Raymond D. Semlitsch & Kathleen M. Trauth & Arnold D. Williams. Influences of Design and Landscape Placement Parameters on Amphibian Abundance in Constructed Wetlands. 06 June 2010.
9. Donna Hazell a, Jean-Marc Hero b, David Lindenmayer a, Ross Cunningham. A comparison of constructed and natural habitat for frog conservation in an Biological Conservation 119, 2004: pp. 61–71.
10. Scott D. Peacor, Earl E. Werner. trait-mediated indirect interactions in a simple aquatic food web. 01 June 1997: pp. 1146–1156
11. Geoffrey Heard; Peter Robertson; Michael Scroggie. Microhabitat preferences of the endangered Growling Grass Frog Litoria raniformis in southern Victoria Australian Zoologist, 2008, 34 (3): pp.414-425.

12. Geoffrey Heard, Michael Scroggie, Nick Clemann. Guidelines for managing the endangered Growling Grass Frog in urbanising landscapes. Arthur Rylah Institute for Environmental Research Department of Sustainability and Environment, January 2010: pp. 2–23
13. State wide integrated flora and fauna team. growing Grass Frog. swifft, 2023.
14. Daniel F. Gomez Isaza, Rebecca L. Cramp, Craig E. Franklin. Living in polluted waters: A meta-analysis of the effects of nitrate and interactions with Volume 261, June 2020.
15. J D Rouse, C A Bishop, J Struger. Nitrogen pollution: an assessment of its threat to amphibian survival. Environ Health Perspect. 1999 Oct, 107(10). pp. 799-803.
16. Courtice, G.P. & G.C. Grigg . A taxonomic revision of the Litoria aurea complex (Anura: Hylidae) in southeastern Australia. Australian Zoologist. 1975, (18): pp.149-163.
17. Frogs Australia Network . Litoria raniformis. Australian Frog Database. 2005.
18. Germano, J. & H. White . Litoria raniformis (Southern Bell Frog): clutch size. Herpetological Review. 2008, 39: pp. 461-462.
19. Neutel, A., Heesterbeek, J. A. P, de Ruiter, P. D. “Stability in real food webs: Weak link in long loops” . Science. 2002, 295 (550): pp. 1120-1123.
20. Littlejohn, M.J. . Amphibians of Victoria. Victorian Yearbook. 1982, 85: pp. 1-11.
21. Tillyard, Angus & Robertson. Insects of Australia and New Zealand. Sydney, 1926, p. 65.
22. Dave Smallshire & Andy Swash. Britain’s Dragonflies. British dragonfly society. 2014.
23. Donna Hazell. Frog ecology in modified Australian landscapes: a review. Wildlife Research. 25 July 2003, 30(3): pp.193 - 205.
24. Tyler, M.J. ’The Action Plan for Australian Frogs.” Wildlife Australia: Canberra, 1997.
25. Clemann, N. & G.R. Gillespie. National Recovery Plan for the Southern Bell Frog Litoria raniformis. Department of Sustainability and Environment. Melbourne. In effect under the EPBC Act from 10-Feb-2012.
26. Victoria State Government. 2023. Flora and Fauna Guarantee Act Threatened List. retrieved: Juanuary 12, 2023
27. Winneke Treatment Plant, Melbourne Water, 2007.