Romer's Tree Frog *(Liuixalus romeri)*

Species Action Plan

2022-2027

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Compiled by the Agriculture, Fisheries and Conservation Department

Acronyms and Abbreviations

AFCD	Agriculture, Fisheries and Conservation Department
IUCN	International Union for the Conservation of Nature
KFBG	Kadoorie Farm and Botanic Garden
LU	Lingnan University
OPHK	Zoological Operations and Conservation Division, Ocean Park Hong Kong

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1. Introduction

Endemic to Hong Kong, Romer's Tree Frog (盧氏小樹蛙, *Liuixalus romeri*) was originally recorded from four islands, Lamma, Chek Lap Kok, Po Toi and Lantau Islands. To mitigate the impact of the Chek Lap Kok Airport construction on the native population, individuals were collected beforehand and captive bred for subsequent relocation to various locations in the New Territories and Hong Kong Island, including several Country Parks, from 1993 to 1996 as part of a doctoral research based on extensive surveys and assessment of suitable localities by Lau (1998). The natural and translocated populations have been observed to be largely stable based on the continuous monitoring programme by the Agriculture, Fisheries and Conservation Department (AFCD) since 2002. However, there have been concerns that the population may be in decline in recent years at Chek Lap Kok and lower numbers were observed in Po Toi.

Romer's Tree Frog is listed as Endangered in the International Union for Conservation of Nature (IUCN) Red List according to the assessment published in 2020. This species is locally protected under the Wild Animals Protection Ordinance (Cap. 170). Ever since the species translocation to various locations, the stable populations are mainly distributed within protected areas and habitats with conservation zonings under the relevant Outline Zoning Plans. However, threats such as construction and demolition waste dumping, if uncontrolled, can cause gradual disturbance and destruction impacts to the habitats in rural environs used by this species at present and in the future. Population reduction due to habitat destruction/degradation is countered to some extent by population increase as secondary forest expands/matures. This species was evaluated as Near Threatened in the Hong Kong List of Threatened Species Assessment in 2019.

A species action plan for the conservation of Romer's Tree Frog was first developed following recommendation from a prioritisation workshop led by the Amphibian Ark (AArk), an *ex situ* branch of IUCN Amphibian Specialist Group Conservation Division in 'the Year of the Frog' in 2008. The plan was implemented collaboratively by AFCD, Kadoorie Farm and Botanic Garden (KFBG), University of Hong Kong (HKU) and Ocean Park Hong Kong (OPHK). This document reviews and fine-tunes the scope of the first species action plan, considering the latest information about the conservation status and conservation efforts. By implementing this species action plan, we aim to maintain a stable population and genetic diversity of the Romer's Tree Frog in a five-year period (i.e., 2022 to 2027) in Hong Kong.

2. Background Information

2.1 Taxonomy

Romer's Tree Frog is generally placed under the following taxonomic hierarchy (Fei *et al.*,1999; Li *et al.*, 2008):

Class AMPHIBIA
Order ANURA

Family RHACOPHORIDAE
Genus *Liuixalus*
Species *Liuixalus romeri* (Smith, 1953)
Synonyms *Philautus romeri* Smith, 1953, *Chirixalus romeri* (Smith, 1953); *Chiromantis romeri*

Romer's Tree Frog was first discovered in 1952 by a naturalist J.D. Romer and was later described as a new species and put under the genus *Philautus* (Smith, 1953). Based on the presence of a free-living tadpole stage and the labial teeth formula, Bossuyt and Dubois (2001) suggested that Romer's Tree Frog might either belong to a new genus yet to be described or provisionally placed in the genus *Chirixalus*. On the other hand, Li *et al.* (2008) reviewed the taxonomy of Rhacophoridae using molecular phylogenetics and suggested that Romer's Tree Frog should be placed in the new genus *Liuixalus*. The genetic study by Qin *et al.* (2015) confirmed the endemic status of the species in Hong Kong, when compared to other specimens from Vietnam and different parts of southern China.

2.2 General description

Romer's Tree Frog has an average snout-vent length of 1.5 to 2.5 cm, with females being slightly larger than males. This species is the smallest amphibian in Hong Kong, naturally found on only four islands, namely Chek Lap Kok, Lamma Island, Lantau Island and Po Toi. It has a small head and is characterised by a distinct fold that extends from the eye to the foreleg. The skin is granulated and the digits have small suction discs. The belly is whitish while the back is brownish with a characteristic X-marking.

Amplexus of Romer's Tree Frogs.

2.3 Biology and ecology

According to Lau (1998), Romer's Tree Frog breeds in fishless, oligotrophic, shaded, still or slow-flowing waters, usually associated with forest or shrubland. Small, temporary water bodies such as seasonally inundated wetlands and pools of rainwater contained in tree holes, ceramic pots or even plastic containers, thus avoiding predation by fish, are also suitable breeding habitats. Non-breeding individuals are found in forests, plantations and the clearings within them.

During the breeding season (early March to September), males emit a characteristic metallic cricket-like mating call to attract females (Karsen *et al*., 1998; Chan *et al*., 2005). Females lay up to 120 eggs onto submerged plant debris, stones, branches and vegetation. The tiny tadpoles are free swimming and metamorphosis usually completes in 4 to 6 weeks (Karsen *et al*., 1998; Chan *et al*., 2005; Banks *et al*., 2008). Adults feed on small arthropods such as termites. This species is predominantly nocturnal but sometimes active during the daytime (AFCD, unpublished data).

Tadpoles of Romer's Tree Frog.

2.4 Population status

While there is concern about the lower numbers in Po Toi and that the population may potentially be in decline at Chek Lap Kok in recent years, based on the data from AFCD's continuous monitoring programme, the majority of the natural and translocated populations (locations refer to S.2.5) are largely stable. Details of the monitoring programme are available in S.3.4.

The genetics of the four natural island populations was first studied using isoelectric

focusing (Lau, 1998). Genetic differentiation coincided well with the geographic positions of the four islands, i.e. Po Toi most distinct, followed by Lamma and Lantau, and Chek Lap Kok only has minor difference. In 2006, AFCD commissioned the Chengdu Institute of Biology of the Chinese Academy of Sciences to undertake a study on the genetic diversity of Romer's Tree Frogs, along with a comparison with allied species from Mainland China. The preliminary results indicated that the Guangxi population may represent a sub-species of Romer's Tree Frog. The endemic status of the species in Hong Kong was later confirmed using genetic data (Qin *et al*. 2015). A recent genomic study by Dr Jonathan Fong (unpublished data) revealed three characteristics of the population in Hong Kong: (1) each natural island population (i.e. Lamma Island, Po Toi and Lantau) is genetically unique, (2) translocated populations (locations refer to S.2.5) preserved the unique genetic diversity of the Chek Lap Kok population, and (3) translocated populations are differentiating from each other.

2.5 Distribution

Global and regional distribution

Since the first discovery in 1952 by J.D. Romer, the frog was later found to be new to science and was named after him as *Philautus romeri* which is commonly known as Romer's Tree Frog (Smith, 1953). Subsequent surveys found that the species occurred on three other islands in Hong Kong at Chek Lap Kok, Po Toi and Lantau Island (Lau, 1998; Dudgeon and Lau, 1999) and thus considered an endemic species. While the species was reported to be found at Shiwandashan, Guangxi of China (Mo *et al.*, 2007; Li *et al.*, 2008), its endemic status to Hong Kong was later confirmed in a recent genetic study by Qin *et al*. (2015). In 2021, sighting of Romer's Tree Frog was reported by Guangdong Zhuhai Qi'ao Dangandao Provincial Nature Reserve Management Office in their nature reserve (廣東省珠海市淇澳-擔杆島省級自然保護區) according to their official social media (珠海自然資源 2021), but this report has yet to be verified.

Based on AFCD's unpublished data and communication with experts, populations of the Romer's Tree Frogs at most of the natural and translocation sites in Hong Kong have been relatively stable, with occasional sightings in other localities (see below sections).

Natural populations in Hong Kong

Romer's Tree Frog was originally found on only four islands in Hong Kong, namely Chek Lap Kok, Lamma Island, Lantau Island and Po Toi.

Chek Lap Kok – Before the construction of the Hong Kong International Airport at Chek Lap Kok, Romer's Tree Frog were found in the freshwater marshes on the island (Lau, 1998; Lau and Dudgeon, 1999). After the completion of the airport, a small population of Romer's Tree Frog could still be found in the remnant woodland (Lynch, 2001), with breeding observed in small water bodies created by rainwater in structures such as water troughs, water tanks or plastic pots among some ruins. However, the species has not been constantly observed since 2019 (AFCD, unpublished data; Lingnan University, unpublished data).

Lamma Island – Lamma is the type locality of Romer's Tree Frog, where it is common in the southern part of the island (Lau, 1998; Lau and Dudgeon, 1999; AFCD unpublished data).

Lantau Island – Romer's Tree Frog is common and widespread on Lantau Island. Ngong Ping is reported to support the largest population of this species (Lau, 1998).

Po Toi – The species is found in the eastern and southern part of the Island (Lau, 1998; Lau and Dudgeon, 1999; AFCD unpublished data). The population is reported to be the smallest among the four islands (Lau, 1998) and has been detected in low numbers in recent years (AFCD unpublished data).

Translocated populations in Hong Kong

Romer's Tree Frog monitoring survey.

To mitigate the impact of the Chek Lap Kok Airport construction on the native population of Romer's Tree Frog, individuals were collected beforehand and captive-bred for subsequent translocation (Lau, 1998; Dudgeon and Lau, 1999). The first captive breeding attempt of Romer's Tree Frog was conducted in 1991 by the World Wide Fund for Nature Hong Kong as part of a small rescue operation for the wild population in the northern part of Chek Lap Kok which would be affected by airport development. A large scale captive-breeding programme was launched by the University of Hong Kong in the doctoral research by Dr Michael Lau, who collected individuals from the southern part of Chek Lap Kok. The frogs were kept and captive bred at the University of Hong Kong and Melbourne Zoo and later released into new sites in the New Territories and Hong Kong Island (Lau, 1998). Over 1 100 frogs and 1 600 captive-bred tadpoles were released at the recipient sites from 1993 to 1996. Each site received at least 90 frogs to provide a viable founding population to increase the chance of successful establishment (Lau, 1998). Earthen/plastic pots or

concrete/butynol-lined pools were also provided to increase the number of breeding grounds. Artificially-made water bodies provided safe fishless breeding grounds for the frogs, in particular where the recipient sites lacked suitable natural breeding habitats (Lau, 1998; AFCD unpublished data).

The translocation sites have been monitored since then (Lau, 1998; Chan *et al.*, 2003). Breeding of the species has been observed in the majority of the release sites, such as Kadoorie Farm and Botanic Garden (KFBG), Lam Tsuen, Pat Sin Leng Country Park, Tai Lam Country Park, Tai Po Kau Nature Reserve, Tsiu Hang Special Area and Tai Tam Country Park.

2.6 Conservation

Globally, Romer's Tree Frog is listed as Endangered in IUCN Red List due to its restricted distribution and habitat vulnerability (IUCN SSC Amphibian Specialist Group, 2020). Nationally, the species is listed as a 'Class 2 National Protected Species' in the List of Wildlife under National Key Protection according to the Wildlife Protection Law of the People's Republic of China. The Red List of China's Vertebrates published in 2016 also rated the animal as Vulnerable (Jiang *et al*., 2016).

In Hong Kong, the species is protected under the Wild Animals Protection Ordinance (Cap. 170). Under the ordinance, it is an offence to take, possess, sell or export any Romer's Tree Frog or its tadpoles or eggs, or to disturb the frog or its tadpoles or eggs. Offenders are liable to a maximum fine of HK$100,000 and one year imprisonment.

The habitats of Romer's Tree Frog are protected through planning control and enforcement against incompatible acts. Ever since the translocation to various locations, stable populations are mainly distributed within Country Parks and Special Areas and habitats protected by conservation zonings under the relevant Outline Zoning Plans (OZPs), which is subject to stringent planning control under the Town Planning Ordinance (Cap. 131) and governed by the Environmental Impact Assessment process under the Environmental Impact Assessment Ordinance (Cap. 499). For example, in recognition of the ecological value and scientific importance of Romer's Tree Frog, the HKSAR Government designated Ngong Ping on Lantau Island as a Site of Special Scientific Interest (SSSI) in May 1999. This site is known to support the largest breeding population of the species on Lantau. The SSSI includes a seasonally inundated stream as well as the surrounding forest, plantation and shrubland to protect both the breeding and non-breeding habitats. This area is also zoned 'SSSI' on the Ngong Ping OZP. Most of the areas in which Romer's Tree Frog occurs are zoned 'Conservation Area' (CA) on the Lamma Island OZP. Po Toi Island is largely zoned as CA to conserve the natural habitats that support a high diversity of birds and butterflies and the natural population of Romer's Tree Frog. In addition, any suspected illegal dumping of construction and demolition waste occurring in the lowland habitat used by this species is controlled under the Waste Disposal Ordinance (Cap. 354).

2.7 Threats and challenges

UNAUTHORISED ACTIVITIES AND DEVELOPMENT

While Romer's Tree Frogs are largely distributed in protected areas and areas with conservation zonings, the species is still susceptible to human disturbance and habitat degradation/loss, potentially caused by unauthorised activities and uncontrolled development, especially in rural village environs.

CHYTRID FUNGUS INFECTION (CHYTRIDIOMYCOSIS)

The chytrid fungus (*Batrachochytrium dendrobatidis*), which has caused global fatality in many amphibian species, poses a potential threat to the amphibian community in Hong Kong. AFCD, in collaboration with the School of Marine and Tropical Biology and Amphibian Disease Ecology Group, James Cook University, Queensland, undertook a survey for chytrid in the native amphibians of Hong Kong during 2005–2006. A total of 12 sites and 274 individuals of four species were swabbed and tested for the presence of chytrid. The survey showed that chytrid was absent from the wild amphibian fauna of Hong Kong (Rowley *et al.*, 2007). However, in the later testing conducted by AFCD from 2010 to 2020, sporadic positive results of chytrid fungus in native amphibians were observed. In this subsequent testing, of the 25 species swabbed at 99 sites, 60 samples out of 2556 (i.e., 2.35%) exhibited positive results. While chytrid fungus screening of Romer's Tree Frogs has thus far been negative, we still consider the fungus to be a potential threat to Romer's Tree Frog and other native frogs.

POTENTIAL IMPACT BY EXOTIC SPECIES

The potential threat of exotic Greenhouse Frog (*Eleutherodactylus planirostris*) is of concern as both species may compete for resources. However its impact has not been studied. The tiny tadpoles and eggs of Romer's Tree Frog are also susceptible to predation. For example, predation by the exotic Mosquito Fish (*Gambusia affinis*) in an experimental setting had shown to increase mortality of newly hatched tadpoles (Lau, 1998).

2.8 Climate change

Changes in ambient temperature due to climate change can influence the behavior of amphibians, including breeding. Reproductive cycles of some species in temperate countries showed response to the warming temperature of climate change by breeding earlier (Blaustein *et al.*, 2001). Other potential impacts due to climate change are the increased spread of infectious disease and increased exposure to external stressors like UV radiation and pollutants that may affect the immune systems of amphibians (Kiesecker and Blaustein, 1995; Pounds *et al.*, 1999). Breeding success could be affected by extreme weather conditions, e.g. prolonged periods of drought or heavy rain. Rising sea level and more intense typhoons and the associated storm surges may affect some of the breeding sites close to sea level. Lau (1998) reported a typhoon destroyed two breeding sites. So far, no specific studies have been performed on the influences of climate change to Romer's Tree Frog. It is uncertain how and to what extent the above potential impacts may affect the species.

3. Action Plan

3.1 Aim

The purpose of this action plan is to outline appropriate actions and identify potential capable action parties, for enabling the maintenance of a stable population of the Romer's Tree Frog in a five-year period (i.e. 2022 to 2027) in Hong Kong, and preserve the genetic diversity of the species, making reference to the latest published information.

3.2 Objectives

The major objective is to maintain a stable population of Romer's Tree Frog through a suite of measures, including habitat and species protection by the existing ordinances, continuous population monitoring of the natural and translocation sites, screening of chytrid fungus, preserving genetic diversity, research and public education.

3.3 Timeframe

This action plan covers a period of five years from March 2022 to February 2027. Actions of each aspect are elaborated in S.3.4 and the timeline and responsible party(-ies) of each action is tabulated in S.3.5. Implementation of actions will be subject to circumstances and conditions of the responsible party(ies) as well as other relevant statutory requirements.

3.4 Actions

HABITAT PROTECTION

Action (1): To continue protection of major habitats of Romer's Tree Frog

- Description: The major habitats of Romer's Tree Frog will continuously be protected under the existing mechanism. The distribution of Romer's Tree Frogs mainly lies within Country Parks and Special Areas, and areas protected by conservation zonings with development control under the relevant OZPs. With Romer's Tree Frog successfully established itself in most translocation sites and commonly occurring in its natural areas of distribution, populations in Hong Kong are considered largely secure and stable.
- Agency(-ies): AFCD, relevant Government Departments
- Timeline: Ongoing

SPECIES PROTECTION

Action (2): To establish a secure, viable *ex situ* assurance population of Romer's Tree Frog

- Description: Husbandry techniques and captive breeding requirements of the

species have been well established based on the translocation exercise undertaken for impact mitigation of the Airport construction (e.g., Banks *et al.*, 2008). Besides, Ocean Park has been running a Native Species Captive Breeding and Education Display Programme and has been collaborating with AFCD to maintain a small captive breeding population of the Romer's Tree Frogs since 2005. When need arises, subject to the findings of continuous population monitoring on the detection and spread of chytrid fungus within the territory, the establishment of a secure, viable *ex situ* assurance population of Romer's Tree Frog will be considered. If an *ex situ* breeding programme is to be proceeded, the population should be captive bred preferably in at least two separate facilities to reduce the risk of collapse of the entire captive population due to diseases or other factors.

- Agency(-ies): AFCD, KFBG, OPHK
- Timeline: When need arises (subject to results of population monitoring and situation of chytrid fungus)

RESEARCH AND MONITORING

Action (3): To continue monitoring of populations at natural and translocation sites

- Description: Continuous monitoring will be carried out by various parties to keep track of the population of Romer's Tree Frog. The Herpetofauna Working Group of the AFCD has undertaken an ongoing monitoring programme of Romer's Tree Frog since 2002 to maintain focus on the survival of Romer's Tree Frog in its natural and translocation sites, as well as evaluate the condition of these sites. Monitoring of each site is conducted during the breeding season from March to September each year. Data on the habitat condition, presence and estimated number of eggs/tadpoles/adults (by mating calls), and locations of frog sighting are recorded. Targeted surveys covering suitable habitats around the translocation sites are needed to ascertain the spread and distribution of this species. Habitat enhancement measures will be carried out as needed, such as installing breeding pots (with piles of branches/fallen leaves if necessary) and creation of small breeding pools. Since 2019, KFBG has undertaken monitoring of the species at its 'Phase 2' site during the breeding season to determine the translocation success, with one final tadpole translocation planned for 2022. LU also has planned to collect data of unmonitored population on Lantau and evaluate the use of automated audio recorders for population monitoring.
- Agency(-ies): AFCD, KFBG (target at KFBG sites only), LU, Michael Lau
- Timeline: Ongoing

Action (4): To investigate current population status and habitat condition at Chek Lap Kok and Po Toi

- Description: In response to the concern about a potential recent population decline in Chek Lap Kok and relatively low numbers in Po Toi, a comprehensive survey will be conducted to gauge the current population status and evaluate habitat condition of the sites. Survey schedule, method and parameters would be coordinated among the parties involved. Reference would also be made to the findings of the research study by LU described in Action (7). Findings from the survey will be used to determine if further actions are needed for these two

populations.
- Agency(-ies): AFCD, LU, Michael Lau
- Timeline: 2022-2027

Action (5): To continue surveillance and monitoring of chytrid fungus in local amphibians

- Description: Chytrid fungus is a global threat to amphibian populations. Sporadic positive results were observed in a few native amphibian species (but not Romer's Tree Frog) in recent years. Given that the risk of infection cannot be ruled out, continued monitoring of chytrid fungus, coupled with our regular surveys in streams and catchwaters (refer to Action (3)), will therefore be conducted to keep track of the risk of chytrid fungal infection to local amphibian species, including Romer's Tree Frog, in Hong Kong.
- Agency(-ies): AFCD
- Timeline: Ongoing

Action (6): To identify genetic characteristics of Romer's Tree Frog

- Description: The genetics composition of the natural and translocated populations were examined and the endemic status of Romer's Tree Frog was verified in the previous studies (see details in S.2.4). However in view of the recent reported sighting in Guangdong Zhuhai Qi'ao Dangandao Provincial Nature Reserve, (S.2.5 refers), a genetic study will be performed to compare the specimens from Guangdong (if collection is possible) and Hong Kong for genetic differences/similarities.
- Agency(-ies): Interested parties
- Timeline: 2022-2027

Action (7): To study potential impact of Greenhouse Frog and mosquito larvicides

- Description: To understand the potential impact by exotic Greenhouse Frog, a research study on the dietary overlap between Greenhouse Frog and Romer's Tree Frog will be conducted. The potential impact of mosquito larvicide on tadpoles of Romer's Tree Frog may also be looked into.
- Agency(-ies): LU
- Timeline: 2022-2027

COMMUNICATIONS AND PUBLICITY

Action (8): To establish education and publicity programmes for enhancing awareness

- Description: OPHK and AFCD jointly launched a Native Species Captive Breeding and Education Display Programme involving Romer's Tree Frogs and other native amphibians in 2006 and 2008. Educational displays of Romer's Tree Frog were also set up in Hong Kong Wetland Park to commemorate the Year of the Frog in 2008. OPHK is currently keeping a few individuals of Romer's Tree Frogs at the back house from the previous education display. KFBG also promotes the Romer's Tree Frog conservation project via education display at KFBG and articles on KFBG's website and Facebook page. New initiatives in joint education and publicity programmes, including citizen scientists, amongst participating organisations will

be explored to improve public understanding of this endemic species and arouse public awareness.
- Agency(-ies): OPHK and other interested parties
- Timeline: 2022- 2027

3.5 Action timetable

Actions		Agency(-ies)	Timeframe
Habitat protection			
(1)	To continue protection of major habitats of Romer's Tree Frog	AFCD, relevant Government Departments	Ongoing
Species protection			
(2)	To establish a secure, viable *ex situ* assurance population of Romer's Tree Frog	AFCD, KFBG, OPHK	When need arises
Research and monitoring			
(3)	To continue monitoring of populations at natural and translocation sites	AFCD, KFBG, LU, Michael Lau	Ongoing
(4)	To investigate current population status and habitat condition at Chek Lap Kok and Po Toi	AFCD, LU, Michael Lau	2022-2027
(5)	To continue surveillance and monitoring of chytrid fungus in local amphibians	AFCD	Ongoing
(6)	To identify genetic characteristics of Romer's Tree Frog	Interested parties	2022-2027
(7)	To study potential impact of Greenhouse Frog and mosquito larvicides	LU	2022-2027
Communications and publicity			
(8)	To establish education and publicity programmes for enhancing awareness	OPHK and other interested parties	2022-2027

4. Implementation and Reviews

Actions laid out in this action plan will be carried out by the corresponding agencies according to the set timelines. Funding for the implementation of actions will be sought by the responsible agencies. Participating parties should maintain communication and undertake interim review if necessary. Review of this action plan, including monitoring and survey data, should be conducted towards the end of the 5-year period by the participating parties.

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