SPECIES ACTION PLAN FOR ROMER'S TREE FROG (*Liuixalus romeri*) IN HONG KONG

A follow-up report to the Prioritisation Workshop for Species in Hong Kong and Guangdong led by the Amphibian Ark (IUCN) on 22-23 May 2008

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PARTICIPATING ORGANISATIONS

Herpetofauna Working Group
Agriculture, Fisheries & Conservation Department

Fauna Conservation Department
Kadoorie Farm and Botanic Garden

Aquarium Department
Ocean Park Hong Kong

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CONTENT

1. BACKGROUND

The Association of Zoos and Aquariums highlighted the year 2008 as the Year of the Frog, a globally coordinated public awareness campaign to mark a major conservation effort to address the amphibian extinction crisis worldwide. The Amphibian Ark (AArk), which serves as the *ex situ* branch of IUCN Amphibian Specialist Group Conservation Division, is leading zoos, botanical gardens and aquariums of different countries in this campaign. One of its major goals is to create partnerships among zoos, aquariums, botanical gardens, private and public institutions (universities, etc) around the world to ensure the global survival of amphibians.

On 22-23 May 2008, AArk in collaboration with Ocean Park Hong Kong, organized a prioritization workshop for the amphibian species in Hong Kong and Guangdong. The workshop aims to identify priority species that are most in need of *ex situ* assistance by establishing assurance populations through long-term captive breeding programme. With the participation of herpetofauna experts from Hong Kong and China, a total of 66 species were evaluated during the workshop. Among them, three species scored considerably higher than the others, including the Chinese Giant Salamander (*Andrias davidianus*), Romer's Tree Frog (*Philautus romeri*) and Dayang Newt (*Cynops orphicus*). These species should be accorded higher priority for *ex-situ* conservation consideration. This report presents a proposed five-year action plan for the conservation of Romer's Tree Frog.

2. THE SPECIES

2.1 GENERAL DESCRIPTION

Romer's Tree Frog has an average snout-vent length of 1.5 to 2.5 cm, with female being slightly larger than the male. This species is the smallest amphibian in Hong Kong. It has a small head and is characterized 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.

2.2 TAXONOMY

Romer's Tree Frog is generally placed under the following taxonomic hierarchy (Fei *et al.*, 2000):

Class Amphibia
- Order Anura
  - Family Rhacophoridae
    - Genus *Liuixalus*
      - Species *Liuixalus romeri* (Li *et al*., 2008)
      - Synonyms *Philautus romeri* (Smith, 1953), *Chirixalus romeri* (Bossuyt and Dubois, 2001); *Chiromantis romeri* (Frost *et al.*, 2006)

Romer's Tree Frog was first discovered in 1952 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 & Dubois (2001) suggested that Romer's Tree Frog might either belong to a new genus yet to be described or it should be provisionally placed in the genus *Chirixalus*. On the other hand, Li *et al.* (2008) reviewed the taxonomy of Rhacophoridae using molecular phylogeny and suggested that Romer's Tree Frog should be placed in the new genus *Liuixalus*.

2.3 ECOLOGY

According to Lau (1998), Romer's Tree Frog breeds in fishless, oligotrophic, shaded, still or slow-flowing waters. The breeding sites are usually associated with forest or shrubland, while non-breeding individuals may be found in forests, plantations and the clearings within them.

During the breeding season from early March to September, males emit a characteristic metallic cricket-like mating call to attract females (Karsen *et al*., 1998; Chan *et al.*, 2005). A female frog lays up to 120 eggs onto submerged plant debris, stones or 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. The frogs are predominantly nocturnal.

Romer's Tree Frog breeds in 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.

3. DISTRIBUTION

3.1 REGIONAL DISTRIBUTION

In 1952, naturalist J.D. Romer discovered a tiny, drab-coloured frog in a cave on Lamma Island. 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 – Chek Lap Kok, Po Toi and Lantau Island. As there was no record of the species anywhere else outside Hong Kong, it was considered to be endemic (Lau, 1998; Dudgeon & Lau, 1999). A recent report suggested that Romer's Tree Frog also occurs at Shiwandashan, Guangxi of China (Mo *et al.*, 2007; Li *et al.*, 2008). However, the study did not to include any specimen from Hong Kong for comparison. On the other hand, a joint genetic study by Chengdu Institute of Biology and AFCD suggested preliminarily that the Guangxi population may represent a sub-species of Romer's Tree Frog.

3.2 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 construction of the Hong Kong International Airport at Chek Lap Kok, Romer's Tree Frogs were found in the freshwater marshes in the northern and southern parts of the island (Lau, 1998; Lau & Dudgeon, 1999). To help conserve the population of Romer's Tree Frog at Chek Lap Kok, individuals were collected from the island and subsequently translocated to other sites in the New Territories and Hong Kong Island. Romer's Tree Frog can still be found in the remnant woodland in the eastern knoll (Scenic Hill) of Chek Lap Kok (Lynch, 2001). Breeding has been observed in small water bodies created by rainwater in trash or structures such as water troughs, water tanks or plastic pots among some ruins in the breeding season and a small population remains (AFCD, unpublished data).

Lamma Island – Lamma is the type locality of Romer's Tree Frog, where it is common in the southern part including Lo So Sing, Sok Kwu Wan, Mo Tat, Mo Tat Wan, Yung Shue Ha and Tung O. It also occurs in Yung Shue Wan and Hung Shing Ye in the northern and the western parts of Shan Tei Tong (Lau, 1998; Lau & Dudgeon, 1999; AFCD, unpublished record).

Lantau Island – Romer's Tree Frog is common and widespread on Lantau Island and has been recorded from Ngong Ping, Yi O, Shui Lo Cho, Fan Kwai Tong, Tei Tong Tsai, Tung Chung, Wong Lung Hang, Sunset Peak, Yi Tung Shan, A Po Long, Pak Ngan Heung, Lin Fa Shan, Mui Wo, Wang Tong, San Shek Wan, Tong Fuk, Shui Hau, Shek Pik, Sham Wat and Keung Shan (Lau, 1998; Lau & Dudgeon, 1999; AFCD, unpublished record). 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 in Shan Liu, Wan Tsai, Ngong Chong and Lau Shui Hang (Lau, 1998; Lau & Dudgeon, 1999; AFCD, unpublished record). The population there is known to be the smallest among the four islands (Lau, 1998).

3.3 TRANSLOCATION POPULATIONS IN HONG KONG

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 relocation (Lau, 1998; Dudgeon & Lau, 1999). Suitable recipient sites were identified in the New Territories and Hong Kong Island. Over 1,100 frogs and 1,600 captive-bred tadpoles were released to 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 lack suitable natural breeding habitats (Lau, 1998; AFCD unpublished record).

The recipient sites have been monitored since then (Lau, 1998; Chan *et al.*, 2003). Breeding has been confirmed at all sites except Tin Fu Tsai. Establishment at the Tin Fu Tsai site is believed to have failed as no frogs had been found after years of monitoring and the exotic tree plantations is believed to be unsuitable habitats for this species. Romer's Tree Frogs bred at the Hong Kong Zoological and Botanical Gardens

(HKZBG) in the first few years and even spread a short distance but no frog was recorded afterwards. On the other hand, monitoring results indicate that Romer's Tree Frogs have dispersed from some of the other release locations to the surrounding habitats though the range and population size of the frogs remain small in most sites. The existing status of the successful release locations are detailed below:

Kadoorie Farm and Botanic Garden (KFBG), Lam Tsuen – Over 90 individuals were released on the hillside of KFBG. Artificial breeding pots were set up in two locations (Lower Conservation Area and Upper Conservation Area) at Kwun Yam Shan. Breeding was confirmed in artificial pots initially in both locations but establishment in the Upper Conservation Area was believed to have been unsuccessful because no frogs have been seen there for several years, probably because of predation by Lesser Spiny Frogs at the breeding pots. In the Lower Conservation Area, recent monitoring showed that the use of artificial pots may not be sustainable as many pots disappeared or got washed down in the steep hillside..

Pat Sin Leung Country Park – Successful reproduction has been noted from the translocation population at the release site in a riparian area of a small stream at Lau Shui Heung. The frogs made use of the artificial pots for egg laying and tadpoles were found during the annual monitoring programme. Recent surveys indicated that the population was expanding from the release site as individuals were recorded from nearby marshy habitats.

Tai Lam Country Park – The frogs were released in a seasonally inundated marsh adjacent to a small stream. Individuals were found to use the artificial pots for breeding. Up to several hundred tadpoles has been found in a single pot. In one year, some males were found calling near rain-filled pools some distance away from this marsh.

Tai Po Kau Nature Reserve – The frogs were released in in Tai Po Kau Nature Reserve. The species had successfully established in the nature reserve and tadpoles have been found in artificial pots. Males were found calling near a stream side pool a short distance away from the release location in one year.

Tsiu Hang Special Area – The frogs released in the Special Area had well established and also records of individuals have been made in adjacent areas. Large number of calling males had been found in a seasonally inundated marshy area at Tui Min Hoi Chuen which is some 500m away from the original release site. Several calling males were even found at Ma Lam Wat nearly 2 km away.

Tai Tam Country Park – Breeding was confirmed at the release site in Tai Tam Country Park. The frogs occur in the marshy habitats at the release site and the surrounding areas. Tadpoles were found in the artificial pots set up at the release site.

4. CONSERVATION

4.1 PROTECTION STATUS

Romer's Tree Frog is listed as "Endangered" in the IUCN Red List [Category – EN 1ab(iii, iv) + 2ab(iii, iv)]. 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 and its eggs, or to disturb the frog or its eggs. Offenders are liable to a maximum fine of HK$100,000 and one year imprisonment.

The HKSAR government's policy on wildlife conservation is to promote the protection of ecosystems and important habitats, and maintenance of viable populations of species in the natural surroundings. Important habitats are protected through planning control and enforcement against incompatible acts. For Romer's Tree Frog, its main habitats are in the relatively flat lowland areas. While a number of the important breeding sites fall within the protected areas, some breeding sites fall outside the existing protected areas. For example, the establishment of Ngong Ping Site of Special Scientific Interest (SSSI) and the zoning of a large part of South Lamma as Conservation Area (CA) and SSSI has added protection to the important breeding populations there. However, some other important sites pointed out by Lau (1998) such as South Po Toi and the forested areas of Mui Wo, Cheung Sha, Shui Hau and Yi O are located outside protected areas. South Po Toi is especially important as the Po Toi population is the smallest among the four natural populations and is the most genetically distinct (Lau, 1998).

4.2 THREATS

As with other amphibian species, Romer's Tree Frog is susceptible to human disturbance and habitat degradation/loss caused by development. Its endemicity and limited distribution in Hong Kong highly raises the need for conservation of this species. This species usually breeds around small streams, seepages and pools, but breeding success could be affected by adverse factors such as pollution/sedimentation or extreme weather conditions (e.g. prolonged period of drought or heavy rain).

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*) would increase mortality of newly-hatched tadpoles (Lau, 1998). Other predators such as the Lesser Spiny Frog (*Paa exilispinosa*), are believed to prey on the frogs in artificial breeding pots (KFBG, unpublished data).

The chytrid fungus which has been reported to cause global fatality in many amphibian species, also poses a potential threat to the amphibian community in Hong Kong. Preliminary screening for the presence of chytrid fungus in selected native frog species was undertaken in 2005-6, and results showed that the native amphibians of Hong Kong appeared free of the fungus (Rowley *et al.*, 2007). Nevertheless, the risk of chytrid fungal infection to the survival of Romer's Tree Frog should be kept in view.

4.3 DEVELOPMENT CONTROL

In view of the ecological value and scientific importance of Romer's Tree Frog, the HKSAR Government designated the Ngong Ping SSSI on Lantau Island in May 1999. The site was known to support the largest breeding population of the species on Lantau. The SSSI includes the seasonally-inundated stream as well as the surrounding forest, plantation and shrubland in order to protect both the breeding and non-breeding habitats. The area is also zoned "SSSI" on the Ngong Ping Outline Zoning Plan. On Lamma Island, most of the areas in which Romer's Tree frog occurs is zoned "Conservation Area" on the Lamma Island Outline Zoning Plan. Any proposed development that may affect these important areas will be subject to stringent planning control under the Town Planning Ordinance (Cap. 131) and assessment on the associated ecological impact has to be made in accordance with the Environmental Impact Assessment Ordinance (Cap. 499).

5. ACTION PLAN

5.1 OBJECTIVES

The major objective of this action plan is to provide the framework for sustainable long-term conservation work for the Romer's Tree Frog through collaborations between the government conservation authority and other environmental organizations. This will include monitoring of sites of natural occurrence and those where the species has been translocated, and protection and enhancement of important breeding sites. Establishment of *ex situ* assurance populations in secure captive breeding facilities will also be considered and undertaken should such a need arise in future.

5.2 TIMEFRAME

This action plan covers a period of 5 years from January 2009 to December 2013. Review of the plan should be conducted towards the end of the 5-year period by the participating organisations.

5.3 MONITORING AND HABITAT MANAGEMENT

With its successful establishment in most translocation sites and common occurrence in its natural areas of distribution, the populations of Romer's Tree Frog in Hong Kong are rather secure and stable. However, continual protection of its major habitats is essential to ensure the survival of this endemic species. Besides, the tiny frog is still susceptible to other threats such as predation and degradation of habitats. Dedicated conservation efforts, in particular species monitoring, will be essential to keep track of the status of the wild populations.

The Herpetofauna Working Group of AFCD has undertaken an ongoing monitoring program of Romer's Tree Frog since 2002. The purpose of the program is to keep in view the survival of Romer's Tree Frogs in its natural and translocation sites of distribution, as well as the condition of these sites. Surveys are conducted during the breeding season from March to September each year. Data on the habitat condition,

presence of eggs/tadpoles, estimated number of tadpoles/adults, presence of mating calls, and locations of frogs found are recorded. Monitoring of each site is conducted once or twice a year. Habitat enhancement measures such as placing of breeding pots and creation of small breeding pools will be made if needed. In view of the small but distinct population of Romer's Tree Frog at Po Toi, specific habitat enhancement works should be conducted to increase the population there. Placing of breeding pots and planting of native trees could be carried out at the breeding sites within the island with a view to providing more favourable breeding habitats for the frogs.

KFBG also undertakes monitoring of the translocation population in the botanic garden. Spring monitoring (February/March) focuses on site inspection and housekeeping required for artificial breeding structures and habitat management if required. Population status will be confirmed in the mid summer monitoring held in June/July each year. It is clear now that the steep hillside does not provide prime habitats for this species and the artificial breeding pots need regular management. Hence, KFBG is exploring the possibility to establish another population in a newly-acquired flat, forested area.

5.4 RESEARCH

Not much was known about Romer's Tree Frog since its discovery in 1952 until the early 1990s when Chek Lap Kok was developed into the new airport. The environmental impact assessment (EIA) study conducted for the airport development identified the occurrence of Romer's Tree Frog on the island. As part of the recommendations made in the New Airport Master Plan EIA Report (1991), the University of Hong Kong commissioned a doctoral research on the habitat use of amphibians in Hong Kong, with special emphasis on Romer's Tree Frog. Surveys on the amphibian fauna were conducted over 160 wetland sites across the territory and suitable localities for translocation of Romer's Tree Frog were identified (Lau, 1998). The study also provided a much better understanding of the basic biology and ecology of Romer's Tree Frog. Further research effort will be useful in determining sustainable management/monitoring protocols and identifying more potential sites should translocation of any captive-bred populations is required in future.

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 and comparison with allied species from Mainland China. As mentioned above, the preliminary results indicated that the Guangxi population may represent a sub-species of Romer's Tree Frogs. Upon completion, the results of the study would help to reveal the genetic diversity and confirm the endemicity of Romer's Tree Frog.

In view of the global threat of chytrid fungus to the amphibian population worldwide, AFCD in collaboration with the School of Marine and Tropical Biology and Amphibian Disease Ecology Group, James Cook University, Queensland, undertook a survey for the amphibian chytrid *Batrachochytrium dendrobatidis* in the native amphibians of Hong Kong. A total of 12 sites and 274 individuals of 4 species were swabbed and tested for the presence of chytrid. Although results showed that chytrid was apparently absent from the wild amphibian fauna of Hong Kong, the risk of infection

cannot be ruled out and monitoring in this respect shall be continued.

5.5 CAPTIVE BREEDING PROGRAMME

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 the Chek Lap Kok. The frogs were kept and captive-bred in the University of Hong Kong and Melbourne Zoo and later released into new sites in the New Territories and Hong Kong Island (Lau, 1998). Since August 2005, Ocean Park has been running a Native Species Captive Breeding and Education Display Programme and has collaborated with AFCD in maintaining a small captive breeding population of the Romer's Tree Frogs. Husbandry techniques and captive breeding requirements of the species have been well established as a result of the above works (e.g. Banks *et al.*, 2007).

Another small population is being maintained by the University of Hong Kong which has been rescued from a marsh in Sok Kwu Wan on Lamma Island in 2007 because the habitat was affected by slope works. Breeding has occurred and this population will be released back to the site once the slope works has completed and the marsh was restored.

Consideration should be given to the establishment of a secure, viable *ex situ* assurance population of Romer's Tree Frog should such a need arises, in particular if there is any indication of the spread of chytri fungus to the territory. If *ex situ* breeding program is to proceed, the population should be captive-bred in at least two separate facilities to reduce the risk of collapse of the whole captive population due to diseases or other factors.

In KFBG, experiment with alternative designs and options could be conducted with a view to provide artificial breeding sites within the "Lower Conservation Area" that require minimal or no human input and are predator-safe. Alternative sites within KFBG which may provide the requirements for a naturally self-sustaining population should be explored. If such location is discovered, appropriate approval shall be sought to establish the population following all relevant, local and international guidelines and best practice. Land in the lower area of KFBG that is naturally inundated with water will be most favourable.

5.6 EDUCATION AND PUBLICITY

As part of the Native Species Captive Breeding and Education Display Programme launched by Ocean Park in collaboration with AFCD, Romer's Tree Frogs were put on display in April 2006 and 2008 together with other native amphibian species. During the exhibition period, the keeper provided talks to the public on the basic biology, ecology and conservation of Romer's Tree Frogs. KFBG also has education boards that display the conservation works of Romer's Tree Frog in the botanic garden. Educational displays of Romer's Tree Frog were also set up in Hong Kong Wetland Park

in 2008 in response to the Year of the Frog and there were highly favourable responses from the public.

Further joint education and publicity programmes could be considered amongst participating organizations to improve public understanding of this endemic species and arouse public awareness of the global amphibian crisis and the conservation need of amphibians in Hong Kong. For example, educational talks/tours could be arranged for the local villagers and students of Lamma Island to raise their awareness of the presence and conservation importance of Romer's Tree Frogs living on the island.

6. FIVE-YEAR IMPLEMENTATION SCHEDULE

Aspects	Details	Commencement Date/Frequency	Completion Date	Budget	Action by
Policy and Legislation	Continue enforcement effort under the Wild Animals Protection Ordinance (Cap. 170)	Ongoing	Ongoing	N/A	AFCD
Habitat Protection & Management	• Habitat monitoring of important breeding sites	Annually/ bi-yearly	2013	N/A	AFCD
	• Habitat enhancement of selected sites	2009	2010		AFCD/KFBG/HKU
	• Exploration of suitable alternative sites for Romer's Tree Frogs at KFBG.	2009	2010		KFBG
Captive Breeding Programme	Establishment of a secure, viable *ex situ* assurance population of Romer's Tree Frog.	To be determined	To be determined	To be determined	AFCD/KFBG/OP
Species Monitoring	Population monitoring of important sites	Annually	2013	N/A	AFCD/KFBG
Research	• Exploring suitable sites for possible translocation	2009	Ongoing	N/A	AFCD/KFBG/HKU
	• Research on the genetic diversity of Romer's Tree Frogs.	Ongoing	2009	The study costs HKD376,000 and covers a total of 9 species of amphibians including Romer's Tree Frog.	AFCD
	• Annual monitoring for the presence of chytrid fungus.	2009	2013	$50,000	AFCD/HKU
Education and Publicity	Further education and publicity programmes	2009	2013	N/A	AFCD/KFBG/OP/ HKU

AFCD – Agriculture, Fisheries and Conservation Department
KFBG – Kadoorie Farm and Botanic Garden
OP – Ocean Park Hong Kong
HKU – The University of Hong Kong

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