

OCCURRENCE OF GÜNTHER'S FROG, *HYLARANA GUENTHERI* (AMPHIBIA: ANURA: RANIDAE) IN SINGAPORE

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INTRODUCTION

Günther's Frog, *Hylarana guentheri* (Boulenger) was first described in 1882 as *Rana guentheri* based on specimens from Amoy (now Xiamen), south-eastern China (Frost, 2011). This subtropical species is widely distributed throughout the lowlands of southern China (including Hong Kong), from the Yangtze River to central Vietnam, including the islands of Hainan and Taiwan (Zhao & Adler, 1993: 142; Ziegler, 2002: 93 as *Rana guentheri*; Chan et al., 2005: 158 as *Rana guentheri*; So & Lui, 2007: 69 as *Rana guentheri*). It has been accidentally introduced to, and already become established on the Pacific island of Guam (Christy et al., 2007a, 2007b). See Frost (2011) for detailed taxonomic history and present classification.

This is a relatively smooth-skinned ranid, with prominent dorso-lateral folds, pale brown dorsum and dark brown sides (Yang, 1998). There are three or four dark-brown bars over each leg, and strong dark-brown marbling on the inner thighs and lower sides of the torso. Its tympanum is large, with a white margin. Adults typically grow to about 80 mm in snout-vent length, but exceptional specimens have been known to attain 100 mm or more. *Hylarana guentheri* is characteristically found in open swampy habitats, and is well-suited to life in areas cleared for agriculture, especially rice cultivation. It is one of the many amphibian species that have a commensal relationship with humans (Chan et al., 2005: 161; Pan, 2000: 110–111 as *Rana guentheri*; Fei, 1999: 172, 175 as *Hylarana (Hylarana) guentheri*).



Fig. 1. An adult male *Hylarana guentheri* with a snout-vent length (SVL) of ca. 8 cm, in a pond at the Jurong Bird Park on the afternoon of 10 May 2008. It was observed to be calling intermittently. (Photograph by: Kelvin K. P. Lim).

In its natural distribution, *Hylarana guentheri* breeds from Apr.–Jun., and remains active throughout the northern hemisphere summer (Fei, 1999). Between 2000–3000 eggs, each about 1.5 mm in diameter, are laid in a single-layer cluster on the surface of stagnant or sluggish waters. The larva, growing to about 40 mm in total length, is greyish-green with dark specks on its body, and pale mottling on its tail. Live examples of its spawn and tadpole were illustrated in Yang (1998: 39). The call of the males resembles a muffled dog's bark, each note spaced at intervals of a few seconds.

Adult frogs feed on insects and earthworms, and are active both day and night (Yang, 1998). In southern China, this species is occasionally sold as human food, despite producing skin secretions known to be lethal to other frogs in a confined space (Chan et al., 2005: 161; Pan, 2000: 110–111 as *Rana guentheri*; Fei, 1999: 172, 175 as *Hylarana (Hylarana) guentheri*). In recent studies on the skin secretions of *Hylarana guentheri*, five new peptides with antimicrobial properties were discovered (Zhou et al., 2006).

Singapore has an equatorial climate, and is far beyond the natural range of *Hylarana guentheri*, yet this species has been found here. *Hylarana guentheri* was officially reported for Singapore from the Sungei Buloh Wetland Reserve, based on calls, but without visual or photographic evidence (Chan & Goh, 2010: 110). This article confirms the occurrence of this species in Singapore, citing voucher specimens and additional locations, and suggests how it could have arrived here.

OBSERVATIONS

Since 1997, the first author (TML, a penguin-keeper then) had already noted barking calls emanating from the ornamental water bodies in the grounds of the Jurong Bird Park, along Jalan Ahmad Ibrahim in the south-western corner of Singapore Island. The second author (KL) heard, but failed to locate the source of the barks when he visited the Bird Park on 13 Nov.2005, 1 Oct.2006 and 12 Apr.2008. Eventually, on the afternoon of 10 May 2008, KKPL photographed a frog of about 8 cm snout-vent length (SVL) producing its characteristic call in an artificial pond at the entrance of the Southeast Asian Aviary, floating half-concealed under a water lily pad (Fig. 1).

The general appearance and the diagnostic white ring around its tympanum identified it as *Hylarana guentheri*. KKPL noted that there were at least three other frogs calling in the same pond. Identical calls were also heard in the Flamingo Lake, and from the water features inside and outside the Waterfall Aviary. KKPL visited the Bird Park again in the afternoon on 5 Jul.2008, and subsequently with TML in the late morning of 27 Dec.2010. The calls of these frogs were heard consistently at the same water bodies of the respective exhibits.

The following specimens of *Hylarana guentheri* were collected from the Lim Chu Kang area at the north-western corner of Singapore Island, and preserved as vouchers at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR) at the National University of Singapore. Comparisons with a specimen of *Hylarana guentheri* from the Danang Province of central Vietnam (ZRC 1.11835, SVL: 76.8 mm, coll. Feb.2005) showed that the specimens are conspecific.

- One example (ZRC 1.12420, female, SVL: 76.3 mm, Fig. 2), from near a muddy pool of stagnant water concealed under bushes of simpoh air (*Dillenia suffruticosa*) behind a strip of mangrove forest off the end of Lim Chu Kang Road, photographed and collected by TML on 3 Feb.2008. The specimen was observed crouching quietly on the edge of the pool at around 2130 hours. When repeatedly approached with the camera for photography, the frog abruptly displayed its defensive behaviour (Fig. 2b). This constituted an elevation of its body off the substrate with all fours, accompanied by an inflation of its body as it filled its lungs with air. When this frog was subsequently handled, skin secretions were exuded and exhibited a strong smell that was somewhat reminiscent of crushed garlic.
- Two examples (ZRC 1.12477, female, SVL: 83.8 mm) and (ZRC 1.12478, female, SVL: 78.3 mm), from an aquatic plant nursery at the end of Lim Chu Kang Lane 8, collected by Alvin F. S. L. Lok on the morning of 12 Apr.2011. The frogs were seen on the rim of large fiberglass containers that serve as planters for *Anubias* species, an ornamental aquatic macrophyte. They leapt into the water when approached.

Dissections were performed for all the female specimens from Singapore and none were found to be gravid. Barking calls identified as that made by *Hylarana guentheri* were also heard at the Sungei Buloh Wetland Reserve, also at the north-western corner of Singapore Island. KKPL recorded two individuals there at the freshwater ponds on the evening of 4 Jul.2008, and two from the freshwater pond beside the Outdoor Classroom in the evening of 1 Aug.2008 (Chan & Goh, 2010: 110).

Hylarana guentheri was recorded in an orchid nursery along Lim Chu Kang Lane 3A by Lee Bee Yan. Since January 2011, two individuals were heard in a large well of about 5 m diameter and 10 m deep. According to the observer, the frogs tend to call in the afternoon, even in hot weather, continuing into the night. One of the frogs (SVL ca. 7 cm), was photographed among grasses growing on the brick and concrete walls of the well at 1335 hours on 21 Feb.2011 (Fig. 3).



Fig. 2. Resting (a) and defensive (b) postures of an adult female *Hylarana guentheri* (ZRC 1.12420, SVL: 76.3 mm) from Lim Chu Kang district, encountered on the night of 3 Feb.2008 at 2130 hours. When adopting its defensive posture, the frog elevated its body above the substrate and inflated itself to appear larger to any potential predator. (Photographs by: Tzi Ming Leong).



Fig. 3. An adult male *Hylarana guentheri* (SVL ca. 7 cm), photographed in a well at an orchid nursery along Lim Chu Kang Lane 3A on 21 Feb.2011 at 1335 hours. (Photograph by: Lee Bee Yan).

It had been observed calling while floating on the water, and promptly dived into the depths of the well when disturbed. Identical barking calls from no less than six frogs were also heard by KKPL at the marsh pond in Jurong Central Park, opposite the Boon Lay MRT Station, on 1 May 2011 at around 1515 hours under an overcast sky. No frogs were observed, but the call of an Asian toad (*Duttaphrynus melanostictus*) was also heard at the same pond.

BIOACOUSTICS

Males of *Hylarana guentheri* produce their calls by inflating a pair of globular, sub-gular vocal sacs on either side of their mouths (Yang, 1998: 39; So & Lui, 2007: front cover). In an audio compilation of the different frog calls from Taiwan, those of *Hylarana guentheri* were featured (Wind Records, 2001: Track 9) and sound very similar to those heard among Singapore populations. Detailed analysis and description of its call were performed based on field recordings from Vietnam populations (Ziegler, 2002: 95–96; Fig. 135: spectrogram and oscillogram). From these recordings, it was determined that the: dominant frequency was 400 Hz, call duration was between 104–117 ms, call rate was ca. seven or eight calls per minute (Ziegler, 2002).

Recordings of call sequences were obtained from an individual male calling within a pond in Jurong Bird Park on 27 Dec.2010 and analysed. It was calculated that its frequency range was between 0.3–3.1 kHz, with the dominant frequency at 0.4 kHz. The call duration was only between 110–140 ms. The call intervals were mostly consistent and timed to be between 9.5–10.5 sec. A representative spectrogram of a single call/note was generated (Fig. 4). The overall characteristics and parameters of the Singapore call samples agree well with those previously described from the Vietnam samples. A representative sample of the calls of *Hylarana guentheri* from Singapore (MP3 sound file, 23 sec, three calls) is available for download.

DISCUSSION

As the characteristic muffled barking calls of *Hylarana guentheri* have been heard at the Jurong Bird Park since 1997, we believe there is a self-sustaining population there although its tadpoles have yet to be observed. It is very likely to be established in the Lim Chu Kang-Sungei Buloh area, but this requires confirmation with further surveys. At present,

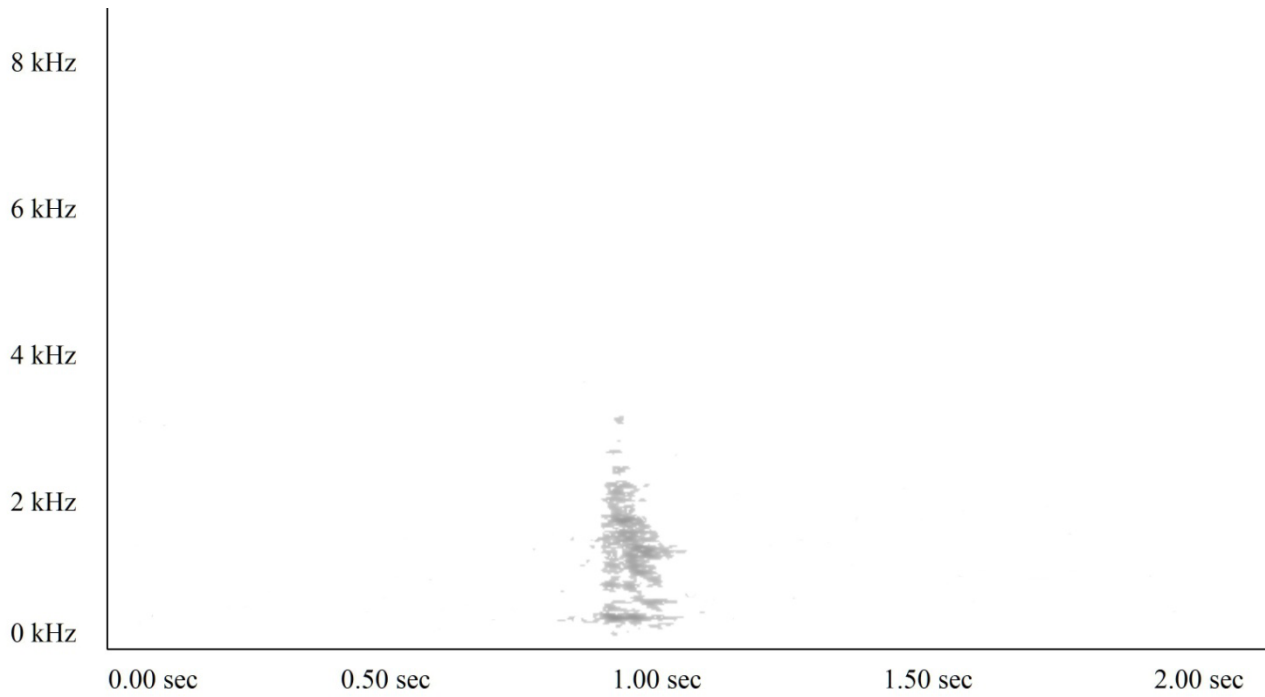


Fig. 4. Representative spectrogram of a single bark-like call of *Hylarana guentheri*, recorded from a male calling from a pond at Jurong Bird Park on the afternoon of 27 Dec.2010 (ca. 1220 hours). The frequency range is between 0.3–3.1 kHz, with the dominant frequency at 0.4 kHz. The call duration is very brief, lasting between 110–140 ms. The call interval is fairly consistent and typically between 9.5–10.5 sec.

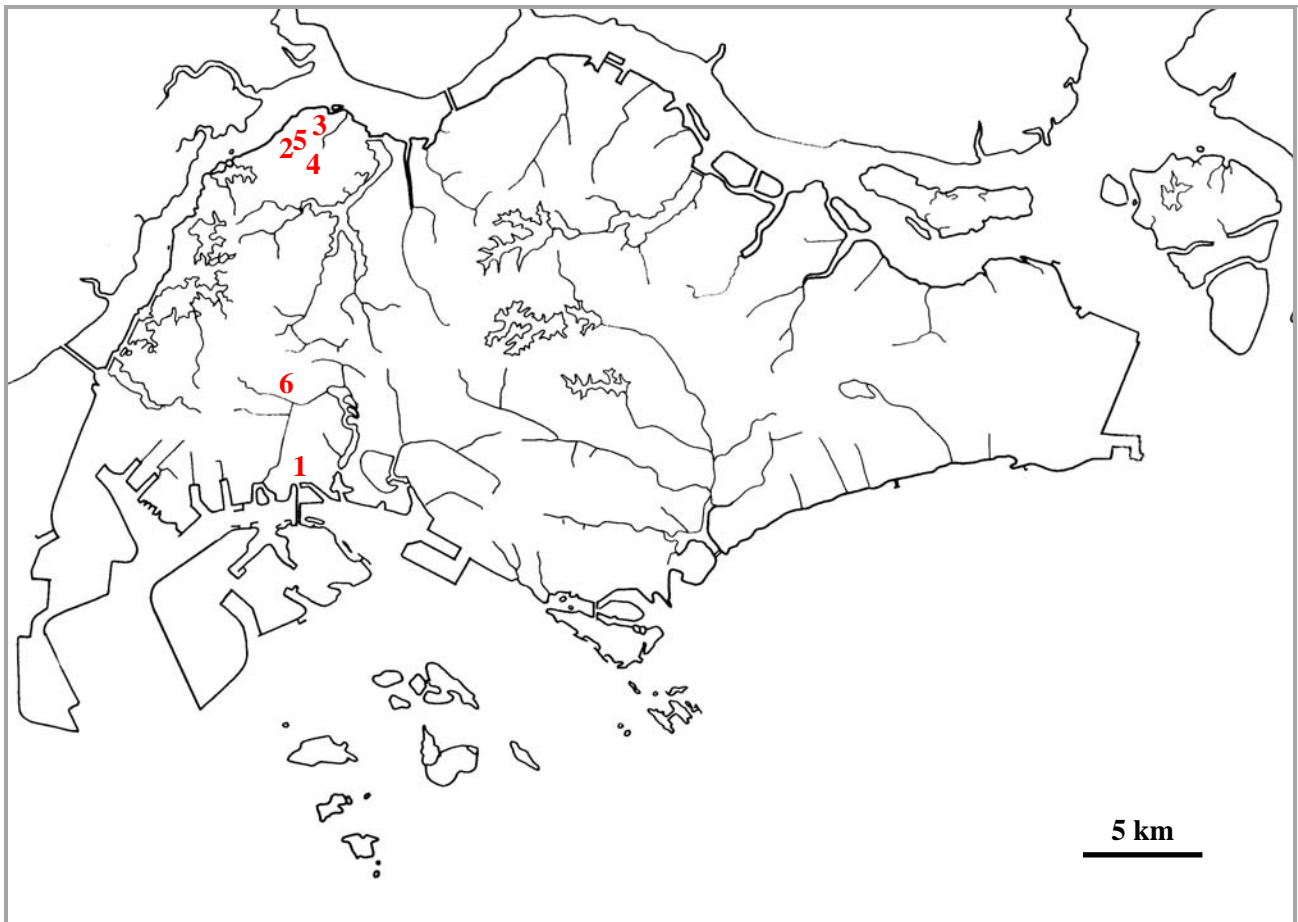


Fig. 5. Presently known distribution of *Hylarana guentheri* in Singapore. They primarily occur in the northwest and southwest corners, mostly residing in man-made or disturbed aquatic habitats. The localities include: (1) Jurong Bird Park, (2) end of Lim Chu Kang Road, (3) Sungei Buloh Wetland Reserve, (4) Lim Chu Kang Lane 3, (5) Lim Chu Kang Lane 8, and (6) Jurong Central Park.

this species is known only from the north-western and south-western corners of Singapore Island (Fig. 5). We have little doubt that the species was introduced, most likely from southern China. The mode of its introduction, however, cannot be ascertained. One possibility is that it was imported unintentionally with ornamental plants, the adults having stowed away in pots of soil. Another possibility is that its tadpoles could have been brought in with food or ornamental fishes. Lim Chu Kang and Sungei Buloh Wetland Reserve are ideal places to find such escaped imports, for they are located in an area set aside for vegetable farms, ornamental plants, and aquaculture. Owing to its drab appearance, secretive habits and nervous disposition, it is highly unlikely that *Hylarana guentheri* was deliberately imported for ornamental or exhibition purposes. In Guam, the influx of *Hylarana guentheri* has been largely attributed to aquacultural imports (Christy et al., 2007a, 2007b).

There is one frog farm in the Lim Chu Kang area. We have visited the facility recently and learnt from the proprietor that only the subtropical American bullfrog (*Lithobates catesbeianus*), is imported and raised there. We have observed that some of the frogs in the farm were spawning, unassisted by hormonal injections. Bullfrog tadpoles were found in the drainage channels within the compound, and it is highly likely that a substantial number would have escaped into the neighbouring waterways. Thus far, we have not heard reports of *Hylarana guentheri* being cultivated for human consumption, and it is not likely that stocks of this species, being of inferior size and bulk, would have been imported for the market here. However, like *Lithobates catesbeianus*, *Hylarana guentheri* is also a subtropical species that appears to be capable of breeding naturally in the tropics.

We do not know if naturalised populations of *Hylarana guentheri* have any negative impact on local anuran species as yet. This frog appears to be extremely shy and difficult to approach, and if not for its distinctive call, may have totally escaped detection. From night surveys conducted once every month in 2008 at the Sungei Buloh Wetland Reserve, it seems to be uncommon at the nature reserve, and there has not yet been a sighting record. Perhaps a detailed monitoring of this species at Jurong Bird Park may shed some light on its interaction with local commensal frog species, especially the green paddy frog (*Hylarana erythraea*), which has a similar appearance and occupies the same habitat. The green paddy frog is readily distinguished by its usually green dorsum, very distinct, white dorso-lateral stripe, and the absence of a white bar at the rear margin of its tympanum (see Baker & Lim, 2008: 63).

At present, we cannot ascertain if the populations at the Jurong Bird Park and the Lim Chu Kang area are historically linked, if the species was imported into one location, and then spread to the other, or if they were brought into the two areas independently and have remained in their respective locations. The population at Jurong Central Park could have originated from the Jurong Bird Park as both localities are linked by the Sungei Lanchar canal. Jurong Central Park is only around 1.5 km upstream of the Bird Park. Surveys have to be conducted in adjacent green areas to see if this species has been expanding its range in Singapore.

To date, the species has not been recorded from the forested areas in the Central Nature Reserves, or from the Western Catchment Area. It is likely to be present in the latter if the population has spread from either north or south, but no barking calls were heard from the marshlands and reservoirs there when both of us participated in faunal surveys on several occasions in the Western Catchment in 2006.

Hylarana guentheri now joins the East Asian ornate chorus frog (*Microhyla fissipes*) and possibly the banded bullfrog (*Kaloula pulchra*) in being relatively new, albeit artificial additions to Singapore's amphibian fauna (see Baker & Lim, 2008: 64–65). This species appears to have adapted well to the managed environment in the compounds of the Jurong Bird Park. It remains to be seen if this species will continue to thrive in Singapore's equatorial climate, and if it has spread beyond the locations where it is presently found.

CONCLUSIONS

Populations of the subtropical Günther's Frog (*Hylarana guentheri*) have been observed in the south-western and north-western corners of Singapore Island, in man-made habitats. It is not possible to determine the exact mode of its introduction, and studies are required to discover its current extent and abundance in Singapore, and whether it will have any negative impact on native fauna.

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