REPTILES & AMPHIBIANS

HUSBANDRY

Sylvia's Leaf Frog (*Cruziohyla sylviae* Gray 2018): Husbandry, Captive Breeding, and Natural History

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Until Sylvia's Leaf Frog (*Cruziohyla sylviae*) was elevated from synonymy with *C. calcarifer* by Gray (2018), the genus *Cruziohyla* contained only two species. Despite the allure of these charismatic frogs and their availability in the pet trade, no existing literature has addressed husbandry since a manuscript by Andrew Gray of the Manchester Museum is no longer available for download at www.amphibianark.org. Responsible captive husbandry not only has the potential to reduce exploitation of wild populations (e.g., Lewis et al. 2019), keeping frogs in captivity offers unique opportunities to observe behaviors rarely observed in nature, especially when dealing with uncommon species (Burghardt and Milostan 1995). Although Donnelly et al. (1987) and Gray et al. (2021) mentioned some aspects of reproductive behavior and larval development, very little is known about this species' natural history (AmphibiaWeb 2021). We herein seek to provide information on husbandry and reproduction applicable in conservation breeding programs of endangered anurans with requirements similar to those of *C. sylviae*.

Captive management of adults and eggs.—Eleven *Cruziohyla sylviae* (4 females and 7 males) were collected under permits for commercial breeding from the Ministerio de Ambiente in Panama. During a 30-day quarantine and treatment with a spray solution of 0.12% Mebendazole for parasites, frogs were housed in ten-gallon tanks (57 x 34 x 32 cm) with acrylic lids without ventilation holes, wet paper-towel substrates, and plastic plants at daytime ambient temperatures of 24–26 °C. As many as four same-sex adults were kept per tank. The tanks were not exposed to UV light or any direct illumination. No water dishes or live plants were deemed necessary as these frogs had no issues maintaining hydration via contact with the wet paper towels.

After the quarantine, frogs were placed in a grow tent (91 x 90 x 182 cm) used as a rain chamber (Fig. 1). The chamber was equipped with a bowl (57 x 44 cm) of dechlorinated tap water (water was conditioned to ensure that chloramines were removed). An automated mister was set to activate for 1–3 minutes every 3–4 hours. A LED single bulb (temperature 6500k) replicated circadian cycles of 11.5 h on and 12.5 h off. Plants (*Monstera*, *Philodendron*, *Epipremnum*, and *Dieffenbachia*) provided hiding places and egg-laying surfaces. Frogs were held in the chamber until eggs were laid or a maximum of three nights.

Two clutches of 7 and 9 eggs were laid, one on the second and one on the third day after frogs were placed in the chamber. Eggs were laid early in the day (before 1100 h), whereas amplexus (Fig. 1A) occurred at night. A third clutch of 28 eggs (Fig. 1B) was laid on 22 December 2022, but the data for that clutch were lost (Table 1). Females laid eggs on branches, stems, or leaves (Gray et al. 2021), then the plant to which the eggs were attached was cut and transferred to a 1-L container filled with 3 cm of treated tap water.

Husbandry of larvae, metamorphs, and juveniles.—Eggs hatched in 9–10 days (Table 1) and tadpoles (Figs. 2A–B) were transferred to 1-L plastic bins in groups of one or two. Tadpoles were fed daily with Tetra Reptomin Floating Food Sticks. The water was kept at 26 °C and 90% was changed each day. Metamorphosis occurred after 57–80 days and metamorphs left the water at SVL = 25 mm (Fig. 2C). Metamorphs resorbed their tails after seven days (Fig. 2D), were fed 2–4 10-mm crickets (*Acheta domesticus*) four times per week, and treated with a spray solution of 0.12% mebendazole for parasites every three months. We supplemented with Repashy Calcium plus two times per week, and Supervite and Super Pig, one time per month, respectively.

Two juveniles developed ascites and liquid accumulation in the coelomic cavity (Fig. 3). We did not have access to testing for the underlying cause but a potential factor was hypoproteinemia, as has been reported in other amphibians (Pessier 2009). Coelomic drainage with a 25-G needle for three days resolved the condition without further complications.

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Figure 1. A pair of Sylvia's Leaf Frogs (*Cruziohyla sylviae*) in amplexus inside the rain chamber (A); a clutch of 28 eggs deposited on 22 December 2022 (B); the rain chamber (C). Photographs by Samuel Sucre.

Feeding in captivity.—We observed feeding in 16 frogs held in six 10-gallon tanks with acrylic lids and moist paper-towel substrates in an air-conditioned room (22–26 °C) (video available at https://youtube.com/shorts/2U_uT1MfEtg). In the period between detecting and capturing prey, frogs lifted their bellies off the substrate and quickly moved their bodies up and down, as described by Kubicki (2004) in *C. craspedopus* (video showing a juvenile exhibiting up-and-down movements while feeding is available at YouTube https://www.yottube.com/shorts/znnp8Tg6YRI). We suggest that this behavior facilitates observation and capture of prey by moving the substrate to trigger prey movement so it can be seen and captured more easily.

Field observation of cannibalism.—Opportunistic cannibalism is common in amphibian larvae (Crump 1983), can have a strong influence on the natural history of species, and should be regarded as an important aspect of a species' ecology (Polis and Myers 1985). At 2121 h on 23 June 2022, we observed *C. sylviae* tadpoles eating conspecific eggs (Fig. 4A) laid on a fallen branch less than 1 cm above the water over a

Table 1. Dates of oviposition and hatching and clutch sizes in captive Sylvia's Leaf Frog (*Cruziohyla sylviae*).

Egg Clutch	Oviposition Date	Hatching Date	Number of Eggs	Date First Tadpole Emerged	Date Last Tadpole Emerged
1	20 October 2022	29 October 2022	7	25 December 2022	1 June 2023
2	23 November 2022	3 December 2022	9	5 February 2023	21 February 2023

Figure 2. A Sylvia's Leaf Frog (*Cruziohyla sylviae*) tadpole at 20 days (A); tadpole at 53 days (B); metamorph after emergence from the breeding pond (C); and juvenile two weeks after metamorphosis (D). Photographs by Samuel Sucre.

permanent pool (Fig. 4B) in Soberanía National Park, Panama (9.0804, -79.6529; elev. 200 m asl) (video available at https://youtube.com/shorts/TopInWDkQpk). The circular concrete pool had a depth of 0.85 m and a width of 1.78 m, water temperature was 24.5 °C, air temperature 26.5 °C, and relative humidity 84%. Egg masses above the water contained 12–26 eggs. We encountered a Rhombic Cat-eyed Snake (*Leptodeira rhombifera*), a potential predator, but did not see it feeding on eggs (Fig. 4C). We also observed calling male Red-eyed Multicolored Treefrogs (*Agalychnis callidryas*) and egg masses (Fig. 4D), but found no tadpoles of that or any other species.

Our results suggest that metamorphosis could occur sooner than previously documented (Donelly et. al 1987; Kubicki 2004; Gray 2018) if temperature ranges are maintained near the upper end of the range of thermal tolerance, results similar to those of Hoogmoed and Cadle (1991) for *C. craspedopus*, in which metamorphosis occurred in less than 100 days. Rearing tadpoles in this way could influence captive-breeding programs by reducing the cost and time of handling tadpoles, which often are more sensitive than adults to suboptimal conditions.

Both the feeding behavior and cannibalism we observed add to our knowledge of natural history of *Cruziohyla*. Additional field observations are required to confirm how potential terrestrial and aquatic predators affect the population dynamics of *C. sylviae* in different life stages. The absence of tadpoles of other species in the pool contrasts with *C. craspedopus*, which is known to share artificial pools with

Figure 3. Juvenile Sylvia's Leaf Frog (*Cruziohyla sylviae*) presenting generalized subcutaneous edema and liquid accumulation in the coelomic cavity. Photograph by Samuel Sucre.

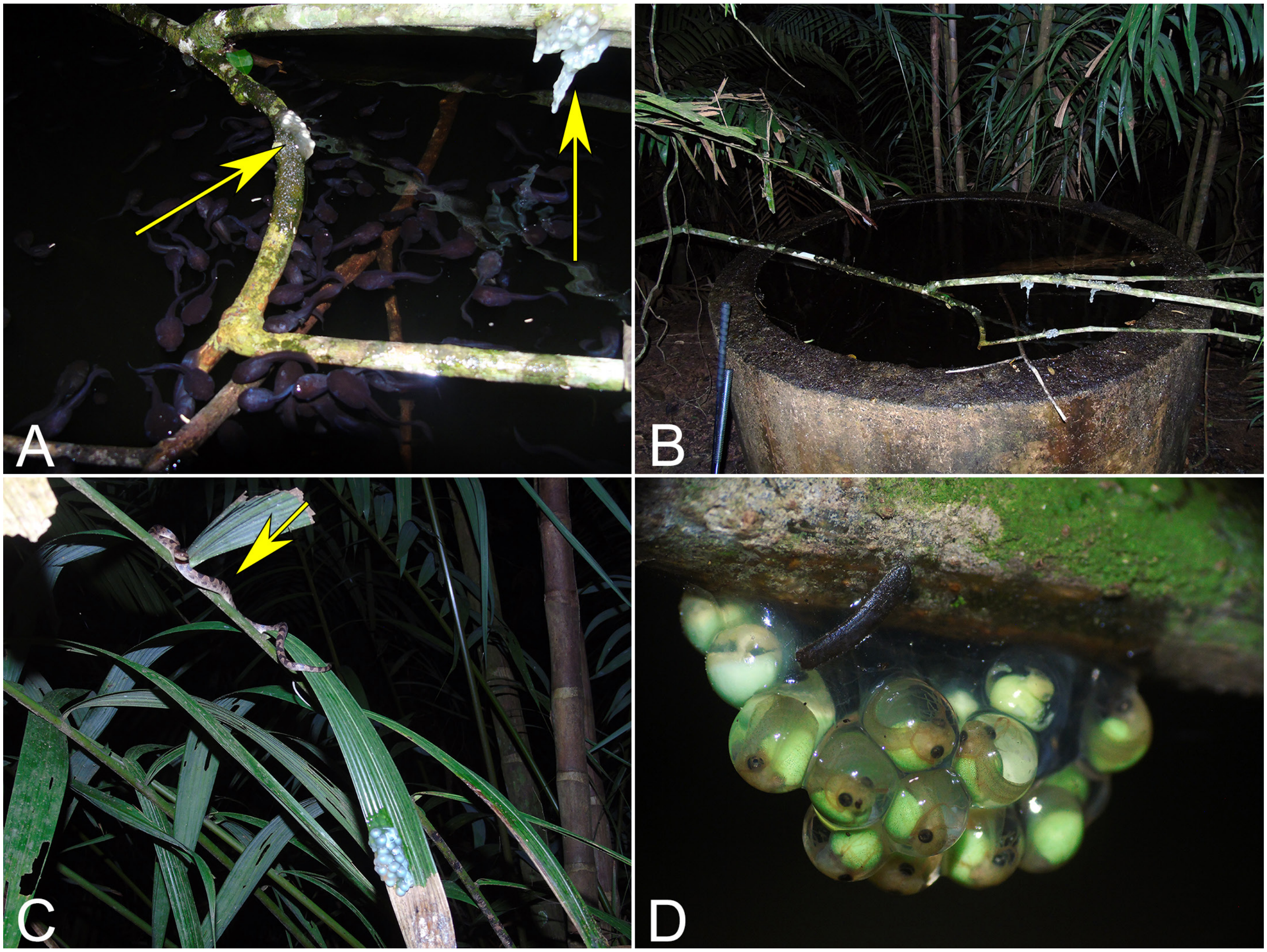

Figure 4. Sylvia's Leaf Frog (*Cruziohyla sylviae*) tadpoles consuming conspecific eggs in Soberania National Park, Panama (arrows indicate egg masses; video available at https://youtube.com/shorts/TopInWDkQpk) (A); artificial concrete pool collects rainwater and serves as a reproductive site for *C. sylviae* (B); a Rhombic Cat-eyed Snake (*Leptodeira rhombifera*) indicated by the arrow is a potential predator of Sylvia's Leaf Frog egg masses (C); an egg mass of the Red-eyed Multicolored Treefrog (*Agalychnis callidryas*) (D). Photographs by Ángel Sosa-Bartuano.

tadpoles of *Phyllomedusa tomopterna* and *Dendropsophus* sp. (Turrell et al. 2016). One possible explanation is that tadpoles of *A. callidryas* or other species are eaten by *C. sylviae* larvae. Snakes in the genus *Leptodeira* include hylid eggs, especially of the genus *Agalychnis*, in their diets (Roberts 1994; Griffis-Kyle et al. 2022), and are likely predators of *Cruziohyla* eggs. We observed only one dragonfly larva, also known to prey on hylid tadpoles (Gonzalez et al. 2011), but these predators could be a factor in some situations.

Sylvia's Leaf Frogs are not difficult to manage and can readily be bred in captivity. Our successful maintenance, reproduction, and breeding of *C. sylviae* provides a model that can be reproduced in breeding and conservation programs for endangered species that have similar requirements — and can reduce harvesting from natural populations.

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