citizen conservation

#Amphibians

Basic information and keeping recommendations for *Staurois parvus*, Lesser Rock Skipper

Content

1. Profile

Scientific name: *Staurois parvus* (Inger & Haile, 1959)
Common name: Lesser Rock Skipper, Bornean Rock Frog
Head-torso length: 2–3 cm
CC#Amphibians-Kategorie: II
Endangerment status according to the IUCN Red List: Vulnerable
Protection status CITES: no
Protection status EU Species Protection Regulation: no
Accommodation: Rainforest terrarium with permanent cascading waterfall, flowing water section and high humidity; cage size for one group at least approx. 100 x 60 x 70 cm. Temperatures all year round approx. 24-25 °C during the day, 22-24 °C at night. Water temperature approx. 22-24 °C.
Required equipment: climbing branches and dense planting. No bottom substrate necessary, only gravel and stones in the water part. The waterfall should run over cascades / stone slabs. Permanently moving water is absolutely necessary! Tadpoles can be reared in the water part of the terrarium.
Feeding: Vitamin-mineral powder-dusted, self-feeding food for the frogs (Drosophila, house crickets, springtails, ovenfish, etc.), fish flake food and pellets for the tadpoles.

2. why is *Staurois parvus* a Citizen Conservation species?

The Lesser Rock Skipper has a very limited range in northern Borneo, where it is closely bound to individual watercourses. Here, even localised habitat degradation (water pollution, deforestation) can easily lead to the extinction of entire populations. According to the IUCN, the population trend is declining and the species is classified as „endangered" on the Red List. It therefore seems sensible to establish and maintain a backup population ex situ, even outside the natural range, for safety's sake.
In addition, *Staurois parvus* is also very suitable from an environmental education point of view to show important aspects of amphibian biology due to its special communication via waving. They are also well suited as ambassadors for the endangered habitat „rainforest", and stable ex-situ populations are also useful for scientific research in our country. Therefore, the species is an asset for display facilities, and for this reason, too, it is desirable to preserve it in terraristics, especially since further imports from the range are not to be expected.

Biology students with Doris Preininger from Vienna's Schönbrunn Zoo conducting scientific research on foot-flagging frogs | Rupert Kainradl

3 Biology and species conservation

3.1 Biology

The genus *Staurois* belongs to the family of true frogs (Ranidae) and includes 6 species that occur exclusively in Borneo and the Philippines. The largest species with about 50-70 mm is *S. latopalmatus*, a dark grey to black coloured frog with unevenly distributed white spots on the back and bright white webbed feet, which can be observed mainly at waterfalls and turbulent cascades. It is the only *Staurois* species that also waves with both legs (Preininger et al. 2009). Slightly smaller is *S. guttatus*, which has a dark brown dorsal colouration on a green background. The skins between the toes, on the other hand, are bluish in colour, the animals signal from branches and leaves hanging over the stream, and surprisingly, the females also call and wave (Grafe & Wanger 2007; Preininger et al. 2016). The smallest species *S. parvus* and *S. tuberilinguis* are monochrome dark grey with single brown or even greenish-yellow spots on the back and clearly white-coloured webbed feet. These two species were only split in 2007 and were previously united under the species name *S. tuberilinguis* (Matsui et al. 2007). The animals now called *S. tuberilinguis* live mainly in higher mountain regions such as Mount Kinabalu, while *S. parvus*, with a body size of only 21-28 mm, is found mainly in lowland regions. The tadpoles of the two species also show some morphological differences (Grosjean & Preininger 2020). *Staurois natator* and *S. nubilis* are similar in appearance to *S. guttatus* and occur in the Philippine islands Mindanao, Leyte, Samar and Palawan.

With a length of only 21-28 mm, *Staurois parvus* is quite rightly called the Lesser Rock Skipper frog | Norbert Potensky

Staurois parvus has only recently been scientifically separated from the other small fiddler frog species *Staurois tuberilinguis* | Ulrich Manthey

The black-spotted foot-flagging frog (*Staurois guttatus*) is one of the larger species of the genus | Norbert Potensky

Staurois natator lives in the Philippines | Norhayati, Shutterstock

The foot-flagging frogs of the genus *Staurois* have developed additional visual communication strategies besides species-specific calls. The most conspicuous visual signal is the so-called „waving". This signal involves lifting a single leg or both legs, slowly extending them outwards and backwards in an arc and bringing them back to the body, with the toes spread apart and thus revealing the brightly coloured skin between the toes. Studies show that the conspicuous signal is quickly recognised by rivals and is often answered in turn by waving. The animals live almost exclusively along fast-flowing, tropical mountain streams and waterfalls in permanently noisy environments. The diurnal males signal all year round from water-washed rocks directly at or in the flowing water. Females, on the other hand, are only found there after rainfall. At night, the animals sleep on leaves of plants hanging over the stream.

Adults of *Staurois parvus* are around 21-28 mm in size and weigh no more than 0.7-0.8 g on average. The females are slightly larger and have a white throat with black spots. The throat of the males is white to bluish without spots. Females usually appear slightly broader on the hind body and eggs can often be seen on the right and left side of the abdomen. The young are light green and turn greyish black in the course of the first year of life. The white colour of the webbed feet also develops only in the first year of life, although already waving is seen immediately after metamorphosis.

The males emit polysyllabic, high-frequency display calls and signal in agonistic (i.e. „hostile") encounters with visual signals. Apart from waving their hind legs, they may briefly raise their arms and legs, straighten up and show the side of their belly, open their mouth wide or inflate only one of the two sound bladders, even without sending a call. If the competitor still does not move from the spot, attacks and short „gnurr" sounds occur. All these signals are also completely normal and desired in human care, because this competition presumably attracts the females to the signal locations and stimulates mating.

The frogs' habitat is restricted to clear mountain streams in primary rainforest. *Staurois parvus* is classified as Vulnerable according to the IUCN Red List Assessment of 2018, because the known distribution area is limited to six fragmented populations and the forest is classified as endangered. The frogs are thought to be found in more locations over the island along clear mountain streams, but this habitat is shrinking as you read this and is being converted to plantations.

Striking communication in the roar of white water: waving *Staurois parvus* | Doris Preininger

Habitat in Brunei - Lesser Rock Skippers live closely tied to fast-flowing rivers in the rainforest
| Doris Preininger

The waving behaviour of frogs was researched in their natural habitat in Brunei with model experiments
| Doris Preininger

3.2 Threat situation

Without clean rivers in the rainforest, no foot-flagging frogs | Norbert Potensky

The biggest threat to frogs is certainly habitat loss. The clearing of tropical rainforests and conversion of forests into oil palm plantations not only fails to provide suitable habitat for a myriad of species, but also leads to pollution of clear mountain streams and changes in water quality through sediment. The dramatic loss of rainforest in Borneo is, in most cases, legal and certified. Most of the local population hardly benefits from the profit and trade of timber, palm oil and other natural resources, the sale and export is done on an international level, mainly to China and Europe.

3.3 Protection efforts

Staurois parvus occurs in three nature reserves on Borneo (Crocker Park National Park/Sabah, Ulu Temburong National Park/Brunei, Gunung Mulu National Park/Sarawak).
In 2008, the Schönbrunn Zoo launched a conservation and research project for foot-flagging frogs in view of the „Year of the Frog" proclaimed by the World Association of Zoos and Aquariums (WAZA) and the IUCN. A container facility was set up and with the permission of the University of Brunei Darussalam and the Brunei Museum Department, the zoo imported 10 individuals of *S. guttatus* and 10 individuals of *S. parvus* from Ulu Temburong National Park to Vienna Zoo.
In addition to several research aspects on the remarkable multimodal (visual and acoustic) signals used in communication, the focus was particularly on reproductive behaviour and the associated conditions that are crucial for reproductive success.

Frog container at Schönbrunn Zoo Vienna for the establishment of an ex-situ population of the Lesser Rock Skipper frog | Daniel Zupanc

4. Keeping

The biggest challenge for keeping foot-flagging frogs is certainly the very humid habitat and, as a result, the required terrarium with continuously running and clean water. Breeding the animals is relatively easy under suitable conditions and possible continuously all year round.

However, the „suitable conditions" are quite demanding for keeping, as the animals live in a tropically humid environment and need a permanently flowing water area for breeding. Therefore, this species is classified in CC category II and is only left to advanced keepers.

In the following, we present here the husbandry conditions that have proven successful in specialised ex-situ husbandry at Schönbrunn Zoo; these husbandry recommendations were essentially drawn up by Doris Preininger of Schönbrunn Zoo.

We would like to emphasise once again that water-intensive keeping is not always recommended in one's own household, so the adoption of animals needs to be well thought through beforehand.

Doris Preininger wrote these recommendations after many years of experience with the breeding of *Staurois parvus* at the Vienna Schönbrunn Zoo | Rupert Kainradl

4.1 Requirements and documentation obligation

As already mentioned under point 3.3, there is no official documentation requirement for the keeping of *Staurois parvus*. The animals therefore do not have to be reported to any authority. The CC animals are the property of the non-profit Citizen Conservation Foundation gGmbH. This also applies to all resulting offspring. Keepers are therefore not allowed to give or sell the offspring themselves.

Experience at Schönbrunn Zoo has shown that the Lesser Rock-skipper reproduces and thrives best when kept together in groups, even across generations. For this reason, CC has dispensed with the usual requirement to separate the generations in this species, meaning that the offspring can remain with their parents permanently and mix with them.

In principle, the Lesser Rock Skipper frog should be kept in CC in so-called species tanks, i.e. not socialised with other amphibian or reptile species. Exceptions to this rule may be possible in consultation with the CC office.

An essential part of CC is the coordination of our inventory, which is why we must always be informed about its development. CC participants are therefore contractually obliged to submit a stock report twice a year, on 1 March and 1 September. This stock report (number of animals, their sex if possible, animals that have died or bred in the last six months) can be submitted online via the Wild at Home platform. We also welcome any observations and experiences gained in keeping and breeding, as an important goal of CC is to generate knowledge about the ex situ husbandry and biology of the species managed in our conservation breeding network. We are also happy to receive photos, which we can then use for publications or social media, for example. Permission to use the images within the framework of the CC programme is deemed to have been granted upon sending them, unless expressly objected to; we always name the authorship of the images in publications, unless expressly objected to.

Please also inform the CC office about deaths informally by e-mail to amphibien@citizen-conservation.org between the stock reports, so that further steps can be discussed if necessary, such as examinations of the other animals, a necropsy or veterinary care.

In the case of clutches and young tadpoles, it is often only possible to make estimates, which are nevertheless helpful. The CC office should also be informed of any successful offspring outside of the stock reports so that new keepers can be found in good time to place the offspring.
If owners can no longer or no longer wish to keep the animals or offspring, the CC office must be informed as early as possible so that we can place the animals in subsequent homes.

Twice a year, a clear view is required - for the inventory report to the CC office | Heiko Werning

For every change of location within CC, i.e. the transfer of animals from one person to the next, veterinary tests must be carried out beforehand; a skin swab for the chytrid fungus *Bd* and a faecal sample for parasites must be tested, if necessary also for *Bsal*. Instructions and the necessary dry swab and faecal sample tubes are provided by CC, the examination costs are borne by CC. A corresponding test order for a suitable test laboratory is available from the CC office. When animals are handed over, a CC handover and origin certificate must be completed.

In principle, the general guidelines of CC and the provisions in the hiring contract apply to all animals kept at CC.

4.2 Transport

Transporting the animals in individual boxes with 5 individuals each on wet kitchen roll paper and moss has proved successful.

When you receive the animals, open the transport boxes directly in the terrarium, do not try to remove the animals individually from the boxes. The frogs are extremely fast and active jumpers. It is best to place the box in the terrarium and let the animals jump out on their own. It is usually easy to encourage the frogs to do this by moving the box.

To avoid transport losses, the animals should not be transported in midsummer or winter. Heat packs and cold packs have proven to be extremely unreliable and are not used for transport. If the animals lie motionless in the box, this may be a stress reaction, and again the condition of the animals should first be checked in the terrarium, as they can regenerate quickly and jump away.

Foot-flagging frogs in transport boxes | Doris Preininger

Five Lesser Rock Skipper frogs can be transported in a box like this with damp kitchen paper and moss | Doris Preininger

4.3 The Terrarium

Above all, the terrarium for the foot-flagging frogs must fulfil the animals' requirements for a very humid habitat. Larger tanks (approx. 100 x 60 x 70 cm) with a large and moving flowing water area are required for breeding.

Around 50 frogs can be kept together in a terrarium of this size. If the water is changed and cleaned frequently and there are enough leaves available as sleeping places, up to 100 animals are possible.

The animals do not require any substrate such as soil, sand or cocopeat, only gravel and medium-sized stones should be present in the water section. The entire bottom area can therefore be filled with water and simple structures (stones, bricks, thick polystyrene sheets, cork) can be used to create an overlying „land section". Be careful, the animals can easily climb up the panes and escape through the smallest openings; the panes and any cable boxes can easily be made escape-proof with foam.

Large terrarium for Lesser Rock Skipper frogs
| Doris Preininger

View of the richly structured terrarium without substrate
| Heiko Werning

Cascade-like structures over which water runs to simulate a splash zone are advantageous. These locations are preferably used as signal locations. The cascades can be easily made yourself using polystyrene sheets and glued to the back walls (e.g. polystyrene parts coloured with black tinting paint for dispersion, which you rinse off well; after drying, simply glue on with tank silicone and rinse repeatedly). It is an advantage if a larger plate is hollowed out a little at the end of the cascade to create a small lacquer.

Medium-sized stones can be placed there, and spawning is favoured in these places. This raised surface is particularly important if there are already tadpoles in the water below, as the tadpoles will eat the new eggs if they are laid in the larger section of water. Homemade cascades can also simply be placed on a clay tile in the water.

In the large breeding tank at Schönbrunn Zoo, the animals only have raised areas where they can spend time. The entire floor section of the terrarium is filled with 15 cm of water.
If the water is pumped from the water section over the cascades using an aquarium pump, the pump should be covered with tights so that tadpoles and young animals are not sucked in.

The tank should never dry out and the walls should also be sprayed once a day if they are not already moist from the „cascade water". The frogs feel particularly at home in high humidity, saturated air and steamy walls.

Cascade inside breeding terrarium in Schönbrunn with lower level for spawning sites | Doris Preininger

Terrarium for permanent keeping at Schönbrunn Zoo | Rupert Kainradl

Water supply and perches for the frogs in the terrarium

The leaves of live plants, which the animals seek out at night, are suitable sleeping places. One leaf often provides a sleeping place for several animals, so there is hardly any competition. You can also count the animals at night if you want to.

Popular sleeping places in the terrarium | Doris Preininger

4.4 Water chemistry, technology and temperatures

Maintenance work in the water section of the aquaterrarium
| Rupert Kainradl

Regular spraying is part of everyday care
| Rupert Kainradl

The temperature should be between 22 and 27 °C, averaging around 24-25 °C (during the day) and lowered slightly at night. The water temperature should also be around 22-24 °C. In private keeping, stagnant water should be used if possible and, if necessary, a UV filter should be connected to the water circuit.

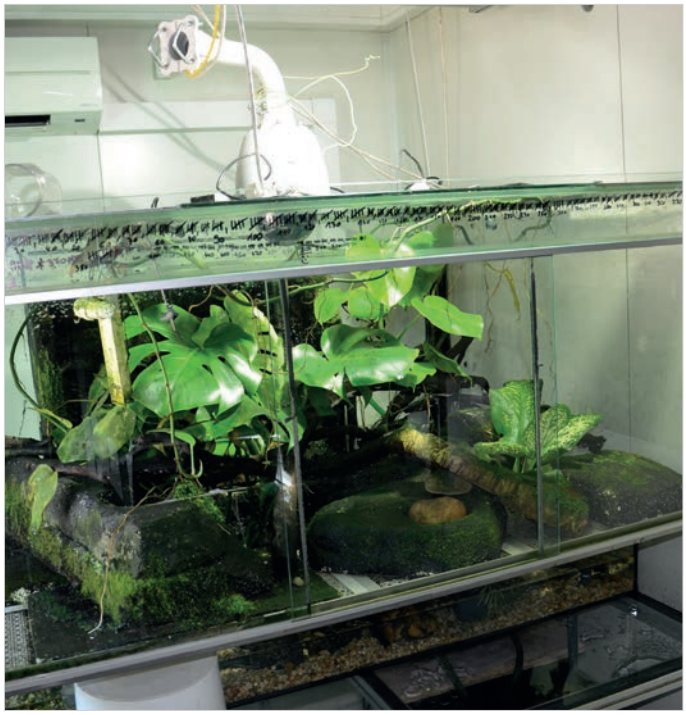
The water values in specialised ex-situ husbandry: total hardness = 0, carbon hardness = 2, conductance ~ 9 µS/cm, pH ~ 7.2. Osmosis water mixed with tap water (drinking water) is used.

The frogs need food adapted to their own size | Thomas Ziegler

4.5 Feeding

The adults are fed two to three times a week with small crickets, gold flies, oven fish and springtails. The young animals are fed micro crickets (first few weeks), *Drosophila* (large and small) and oven fish (few). They are fed as required, daily or every other day. If possible, the feed animals are given flower pollen, fish flakes, „Korvimin ZVT" or feed supplements such as „Repashy Calcium Plus, Amphib". The insects are mainly fed fruit and vegetables, „Superload", „Superpig" and spirulina and can also be dusted with a vitamin mixture (e.g. „Vitakalk", „Korvimin ZVT" or „Nekton MSA"). You can also leave a bowl with banana and additives for *Drosophila* in the tank.

Tadpoles do not eat for the first few days, then they are given fish flakes (spirulina algae and / or animal protein, sturgeon or carp pellets, „Repashy superpig + soilent green" cubes, frozen food (red mosquito larvae, daphnia) and possibly freshwater fish fillet once a week (give this rather rarely).

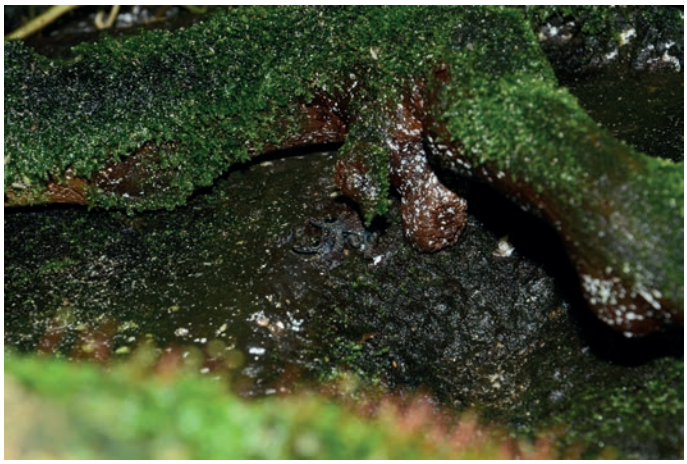


Terrarium for foot-flagging frogs at Schönbrunn Zoo | Heiko Werning

4.6 Breeding

For successful breeding, it is important to keep the animals in groups with several males. The pronounced competition between the males and the associated hormonally stimulated waving is likely to be decisive for mating. The amplexus can last from several hours to days. The females carry the male through the tank and usually lay the eggs in the evening or at night.

The eggs are laid on or under medium-sized (approx. 5-10 cm) stones in shallow (1-2 cm) and deeper (15-20 cm) water areas. A clutch contains 25-50 eggs, which hatch after around one to two weeks.



Pair of Lesser Rock Skipper in the amplexus | Heiko Werning

Two examples of spawning sites in the terrarium | Doris Preininger

The clutches of the Lesser Rock Skipper frog are often pinned under stones | Doris Preininger

4.7 Rearing

The tadpoles take about 3 months to develop. Their behaviour is distinctly photophobic, so they avoid light. They colonise spaces in the coarse gravel or take refuge under stones. They can be attracted relatively easily with food so that they can be observed. Tadpoles of different sizes can be kept together without any problems.

Larvae and juveniles can easily be reared in the tank with the adults if sufficient small food is offered. The metamorphs climb out of the water on the discs; if reared separately in a tank, the tank must be covered as soon as the tadpoles get arms so that the animals do not escape.

Clutch of *Staurois parvus* | Doris Preininger

Tadpoles of *Staurois parvus* | Norbert Potensky

Metamorpholing | Daniel Zupanc

Waving young | Norbert Potensky

4.8 Problems

Once breeding has started, the animals can hardly be stopped. This luxury problem quickly leads to overpopulation, which in turn requires more frequent cleaning of the tank and more frequent water changes. In this case, not all of the clutches should be reared (and perhaps fed to existing tadpoles) in order to ensure an environment largely free of bacteria.

Tadpoles eat a clutch of their own species
| Norbert Potensky

Male *Staurois parvus* with young

5. Further Reading

Preininger, D., A. Weissenbacher, T. Wampula & W. Hödl (2012): The conservation breeding of two foot-flagging frog species from Borneo, *Staurois parvus* and *Staurois guttatus*. – Amphibian and Reptile Conservation 5(3): 45–56.

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Staurois parvus | Daniel Zupanc