

Good practice guidance for the housing and care of *Xenopus laevis*

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Introduction

A comprehensive report entitled 'Guidance on the housing and care of the African clawed frog, *Xenopus laevis*' was published by the RSPCA in 2005. The report drew together for the first time previous research undertaken into *Xenopus* health and welfare along with published guidelines and recommendations on housing and care. The aim was to facilitate a better understanding of these animals and provide some guidance for improving their health and welfare. The report has received much positive feedback and has been disseminated around the world.



Some of the key elements of this report have since been extracted to provide the basis for an easy to use, short summary containing basic information about *Xenopus laevis* and some details of current good practice for their general care. Although originally produced with members of local ethical review committees in mind, the summary below has also proved to be a useful aid to animal technologists and other staff interested in the husbandry needs of *Xenopus* and how to satisfy these in a laboratory

environment. For more specific information, in particular relating to the physical environment, feeding, transport, and common scientific procedures for example, the previously mentioned full report should be consulted.

Natural history

Xenopus laevis, also known as the African clawed frog or the common platanna, originates from southern Africa. The species is carnivorous and can typically be found in stagnant pools, ponds, lakes or ditches where the substrate is usually thick mud. Under normal circumstances they are totally aquatic although they have well-developed lungs and visit the surface to breathe. Females are larger than males, growing up to 15cms from snout to rear compared to 10cms in the male. Individuals regularly live for 10-15 years and it has been suggested the lifespan may be 25-30 years.

As *Xenopus laevis* is nocturnal and typically inhabits a dark and murky environment, vision is not the main sense used for gathering information about their surroundings. Like fish, these frogs have a 'lateral line' of specialised sensory organs that runs in a circle around the back of the body, the head and around the eyes. This highly sensitive system is used to locate prey and detect other disturbances in the environment by perceiving water movement.

The sense of smell is important to *Xenopus laevis*. The frogs are aroused by the odour of food (live or dead) nearby and will swim around in search of the object until they touch it, often only deciding whether to consume the item when it reaches the mouth. The short front limbs are used to direct food towards the mouth while the larger hind legs are primarily used to powerfully propel the frog through the water. They have claws on their hind legs (hence the common name!) which are useful for digging out insects and other food items from the mud, and for shredding larger prey into more manageable-sized portions.

Assessing welfare in *Xenopus laevis* can be difficult, but these frogs can suffer stress through overcrowding, improper handling, over-use in experimental

procedures, or poor water quality. Providing the most suitable housing conditions and care is vital for maintaining frog health and welfare.

Note: Other species of amphibians used in research e.g. *Xenopus tropicalis*, *Rana temporaria* (European common frog) and *Ambystoma spp.* (Axolotls), have their own species-specific requirements.

What *Xenopus* frogs need

The following list of requirements is based on the natural history and behaviour of *Xenopus laevis* frogs as well as published animal welfare studies and recent publications detailing good practice for the care of these animals in the laboratory (see recommended resources).

- **Adequate quantity of water**
When kept in shallow water *Xenopus laevis* frogs show increased startle and escape behaviours and egg production is adversely affected. Water should therefore be deep enough to allow frogs to lie fully submerged well away from the surface, to swim around if they want to (although they may spend the majority of their time motionless) and to allow enrichment (e.g. plastic tubes, for example) to be put into the tank.
Sufficient volume of water should be provided to allow frogs to avoid contact with others. If desired and to turn around in any direction without being impeded by other animals or the sides of the tank.
- **Appropriate group housing**
Group-housing these animals is beneficial since this helps to stimulate 'feeding frenzies', which are normal feeding behaviour. However, care must be taken to allow enough room for each animal, as overcrowding can lead to traumatic injury of tankmates during feeding. Group housing *Xenopus laevis* also reduces their fear responses. Animals kept together should be of a similar stage of development and size to minimise the potential for cannibalism.
- **Appropriate tank housing**
In the wild these frogs usually live in murky water with a substrate of thick mud. In the laboratory they are often kept in clear water in transparent containers which allow light into the tank from all sides (including the bottom and, particularly, from above). This is likely to stress the frogs so tanks should be made of darkened material such as glass or plastic. As a minimum, the floors of the tanks should be opaque. This can easily be achieved by placing the tanks on a dark surface (even thick black card would suffice).
Cleaning tanks with a substrate of deep mud is impractical and it is common for the tank floor to be

left bare. Whilst not representative of natural conditions, a bare floor is preferable to one with a substrate of small stones (gravel). These stones can be accidentally ingested and it is clear from 'choice tests' that frogs do not prefer gravel flooring.

- **Suitable lighting – spectrum and intensity**
The lighting regime should simulate natural conditions with 12-14 hours of light and a gradual brightening/dimming period of around 20-30 minutes in the morning and evening. Strong consideration should be given to including the ultraviolet range, particularly where frogs are to be kept for six months or more. Care should be taken not to expose tanks to bright light, though illumination in the animal house must be of an adequate level to allow observation of the animals and for routine housing and husbandry procedures to be carried out.
- **Appropriate temperature**
Water temperature should not be maintained below 16°C or above 24°C as this may cause stress and could increase susceptibility to disease
- **A refuge**
Frogs are a prey species and in order to feel safe and secure they must have a place where they can seek refuge, as they would in the wild. This requirement can be catered for by providing plastic tubing or plastic 'caves'. Smooth moulded plastic 'rocks' may also be added to the tanks. If objects are positioned a few inches away from the tank wall, frogs will be able to manoeuvre themselves into the gaps, providing additional areas for refuge. Objects added to the tank should be designed to have no

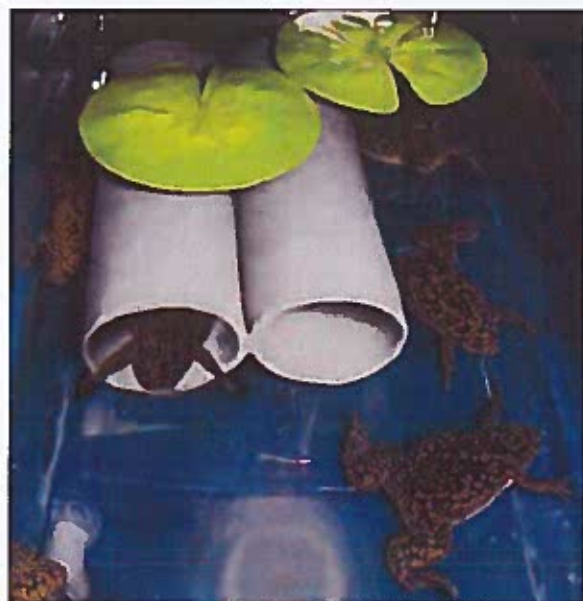


Photo: M. Brown (MRC)

sharp edges, be easy to clean and should not affect water quality. Enrichment items for aquatic animals are commercially available or, alternatively, the piping used for potable water supplies is suitable. For added cover, floating plastic lily pads or bin liners cut into various shapes can be placed on the water's surface (but making sure that frogs still have access to the surface to breathe)

- **Minimal environmental disturbance**
These animals are very sensitive to disturbances in their environment, so vibrations and noise emanating from equipment in the laboratory should be eliminated as far as possible.
- **Careful handling**
In order to minimise stress, handling should only be undertaken when essential. Personnel should wear non-powdered plastic or latex gloves to handle frogs as they have very sensitive skin. To facilitate a quick capture whilst minimising the stress caused to the frog, a deep and strong soft-mesh net should be used to initially remove the frog from the water.
- **Reducing the use of wild caught individuals**
Xenopus laevis frogs should be purpose bred in captivity. In addition to reducing the impact on the wild ecosystem, it has been shown that captive-bred animals habituate to disturbances more readily than those animals taken from the wild.
- **Routine and close monitoring of behaviour and health**
Amphibians are prone to many diseases that are often difficult to treat and control and *Xenopus* may carry a range of pathogens without developing any disease, until exposed to environmental stressors.

A healthy frog is placid, with moderately slimy skin and a nice pear shape, but assessing wellbeing and diagnosing the early stages of disease can be difficult as *Xenopus* have little ability to express their state of welfare. This is because amphibian behaviours can be hard to recognise and interpret and also because *Xenopus laevis* is a potential 'prey' species, so has evolved to hide overt signs of distress, injury or other susceptibility to predation. It is therefore vital that personnel caring for these frogs have a good knowledge of all the clinical signs of the common diseases, and they should routinely and closely monitor the behaviour and health of these animals (see reference 1).

Recommended resources

- ¹ Reed, B.T. (2005). *Guidance on the housing and care of the African clawed frog, Xenopus laevis*. RSPCA, Horsham, UK. Report can be downloaded at: www.rspca.org.uk/xenopus
- ² NC3Rs. *Amphibians*. www.nc3rs.org.uk/information-portal click on "Amphibians".
- ³ Tinsley, R.C. and Kobel, H.R. (1996). *The Biology of Xenopus*. Oxford: Oxford University Press.

NB: to read similar short summaries on good practice for the housing and care of other commonly held laboratory species, visit: www.rspca.org.uk/ethicalreview