

Basic Information and Husbandry Guidelines
for *Ambystoma dumerilii*,
Lake Pátzcuaro Salamander





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1. Characterisation

Scientific name: *Ambystoma dumerilii* (DUGÈS, 1870)

Vernacular names: ake Pátzcuaro salamander (English),
Pátzcuaro-Querzahnmolch (German), Achoque (Spanish)

Snout-vent length: max. 35 cm; total length: max. 47 cm

CC#Amphibians category: I

Threat status according to IUCN Red List: Critically Endangered (CR) – threatened with extinction

Threat status according to CITES: Appendix II

Threat status according to EU Species Conservation Ordinance: Annexure B

Threat status in its native country: Pr (Special Protection) in Mexico

Accommodation: Unheated aquarium in a cool room without direct insolation

Equipment required: Aquarium, oxygenator or filter system,
shelters and (plastic) aquatic plants, aquarium thermometer, gravel cleaner

Feeding: Adult specimens (from ca. 15 cm): earthworms, smelt,
freshwater fish, feeder pellets for Axolotl

Newly hatched larvae to those with nodular hind limbs:

Artemia Larvae to ca. 5 cm: Enchytraeidae,
red mosquito larvae, Tubifex, blackworms

Specimens of ca. 5-10 cm: earthworms,
feeder pellets for Axolotl





2. Why is *Ambystoma dumerilii* a Citizen Conservation species?

Ambystoma dumerilii is threatened with extinction. This species is exclusive to a single lake on the Mexican Highland. It was fished for in large numbers in earlier times. Its natural habitat is small in dimension and suffers from pollution. This species has been grossly overexploited so that conservation measures are unlikely to produce immediate results. The survival of this species appears to be possible only in human care for the time being.

Like its "sister species", *Ambystoma mexicanum*, the Axolotl, *Ambystoma dumerilii* is of great scientific and environmental-pedagogic value due to its unusual biology (neoteny). In the face of the major importance of the Axolotl for biomedical research, comparative studies in *Ambystoma dumerilii* are of particular scientific interest.



Doris Preininger and Thomas Wampula of the Viennese Tiergarten Schönbrunn are Citizen Conversation sponsors of *Ambystoma dumerilii* | Photo: Benny Trapp / Frogs & Friends



3. Biology and Conservation

3.1 Biology

Ambystoma dumerilii forms part of the family *Ambystomatidae* (mole salamanders) within the order of the tailed amphibians (Caudata). Current knowledge suggests that it is exclusive to Lake Pátzcuaro in the northwest of the central Mexican state of Michoacán at an altitude of 1,920 m a.s.l.. A singular additional record from San Juan del Río in the Mexican state of Queretaro is considered highly doubtful.

Lake Pátzcuaro is situated in an arid region that is hostile to the existence of tailed amphibians, which is illustrative of the advantages of neoteny in that the salamanders can remain in the water and do not have to go onto land. In historical times, this lake was devoid of larger predatory fish, but this situation has since changed. On-site studies recorded water temperatures of 14–25 °C, a pH of 8.1–8.8, and an electrical conductivity of 275–760 $\mu\text{S}/\text{m}$ several metres from the shore at a water depth of a few centimetres.

Like its more widely known relative the Axolotl, *Ambystoma dumerilii* is a neotenic salamander. This means that even sexually mature specimens will retain larval traits. They are therefore also referred to as “eternal babies” or “permalarvae”. As such, they will never complete their metamorphosis and turn into a land-living salamanders breathing via lungs, but rather spend all their life in the water breathing via large external gills. They do have lungs, though, and are furthermore able to breathe via their skin. It was only under the conditions of a laboratory that individuals could be observed metamorphosing in a few rare instances. Lake Pátzcuaro salamanders thus maintain the typical appearance of a larval salamander throughout their life, including traits such as external gills. Like the Axolotl, these animals have remarkable regeneration capabilities, which enables them to even regrow entire limbs.

In the wild, total lengths of between 122 and 282 mm (snout-vent lengths: 74–165 mm) have been recorded in adult *Ambystoma dumerilii*, and up to 350 mm in total length may be reached in the aquarium. Males and females do not clearly differ in their adult sizes, even though some males may be slightly larger than the females due to their longer tails. The tail is about half as long as the body, laterally compressed, and enlarged vertically, which is typical of a tail used for swimming. Adult females often appear more rotund when they carry eggs and will then be more round in outline when viewed from above. For their part, the males are notable for their swollen cloacal glands during the mating season. Both sexes have in common that the arms and legs are short but muscular, and the toes are fully webbed.



Ambystoma dumerilii is uniform olive in colour, usually without much of a pattern, but sometimes with minor speckling. The ventral side has a lighter hue. The tips of the fingers and toes are dark or even black. The external gills are reddish brown. The skin covering the head and back sports minute pits that mark the openings of slime glands. The head carries distinctly visible ampullae (sensory organs).

Ambystoma dumerilii resembles the more commonly known Axolotl, *A. mexicanum*, but grows larger, has a more massive head, fully webbed toes, and a granular skin.



Adult Lake Pátzcuaro Salamanders | Photo: Benny Trapp /Frogs & Friends



3.2 Threats

Ambystoma dumerilii has suffered from a significant population decline. Field studies in 2000 and 2010 failed to detect any free-ranging salamanders in Lake Pátzcuaro, but Mexican researchers supporting a team of BBC wildlife filmmakers managed to catch a few individuals at a later stage. Local fishermen still harvested six metric tons of this animal in 1987, and a little less than three tons in 1998, but a mere 0.3 tons in 1999. The salamanders were collected as food and for medical purposes. This overexploitation could have caused the collapse of the already weakened population.



Lake Pátzcuaro on the Mexican Highland – the only place where *Ambystoma dumerilii* occurs | Photos: Joachim Nerz

Ambystoma dumerilii furthermore responds very badly to the pollution of its habitat and compromised living conditions. Water pollution in Lake Pátzcuaro is a major issue, and large portions of the lake have been filled up to gain land. While the impact of introduced predatory fish still has to be investigated, these are possibly an additional serious threat factor. Another problem might have been arisen from in the shape of increased numbers of fish mites from fish and mussels.



3.3 Conservation Efforts

The nuns of a Dominican Convent, the “Predicadores María Inmaculada de la Salud”, situated at Lake Pátzcuaro have for the past 150 years been producing a cough syrup that is based on a secret recipe based on the local salamanders. Responding to the dramatic decline of these animals in the lake over the past decades, the nuns have taken to propagating them in captivity on their premises. There is also an on-site species conservation initiative, the “PIMVS Jimbani Tzipekua”, which was established in 2009, that maintains a breeding station in which these salamanders are successfully propagated.



The breeding station for the endangered *Ambystoma dumerillii* on Lake Pátzcuaro | Photos: Joachim Nerz



An information board on the wall of the Dominican nunnery portrays the Lake Pátzcuaro Salamander and its unusual conservation history



A view into one of the breeding troughs



Troughs for keeping salamanders outdoors in the breeding station on Lake Pátzcuaro



4. Husbandry



An aspect of the Ambystoma Mexicanum Bioregeneration Center (AMBC) of the Medical Highschool Hannover
| Photo: Christina Liebsch / AMBC

The husbandry information provided here is based on the experiences made at the Viennese Tiergarten Schönbrunn (contributed by Doris Preininger, Thomas Wampula, and Anton Weissenbacher), added to which are data from the Ambystoma Mexicanum Bioregeneration Center (AMBC) of the Medical Highschool Hannover (contributed by Christina Liebsch).

Lake Pátzcuaro Salamanders can be successfully kept and propagated under the framework conditions detailed here, but alternative approaches may produce comparable results. If you are contemplating effecting major deviations in their husbandry, you are requested to discuss them upfront with the office of CC#Amphibians. Please also inform the CC Office of complementary observations you may have made. This is intended to continuously grow the pool of knowledge relating to the captive husbandry and propagation of this species and keep it up-to-date.



4.1 Restrictions and Documentation Requirements

With *Ambystoma dumerilii* being listed in Annexure B of the EU Species Conservation Ordinance, keeping it requires registration at the offices of the authority in charge. This will typically be the Untere Landschaftsbehörde; if in doubt, you may simply google "Artenschutz" and the name of your place of residence, which will readily produce a source for the required information.

Registration requires you to submit a photocopy of the certificate of origin that you will have received from the previous owner at CC#Amphibians. We recommend that you additionally submit a photocopy of the "Einstellungsvertrag" (agreement of temporary ownership) that you have entered into with CC.

The specimens remain the property of Frogs & Friends e.V., which acts as the administrator for the Project Citizen Conservation #Amphibians. However, with you being the person effectively keeping these animals, it will be your responsibility to have them properly registered at your place of residence. The authority in charge must also be notified of any changes to the population in your care in a timely manner. You should obtain information upfront on the prescribed procedure and time limits this authority may have imposed. You are furthermore requested to keep the CC#Amphibians Office informed (this can be done by a simple E-mail). The authority in charge must also be informed of any specimens that are transferred by mediation of, or returned to, CC#Amphibians, as this likewise constitutes a change to the captive population.

Registration of captive-bred specimens at the CC#Amphibians Office should be done when juveniles have reached an age of about six months and there will be some degree of certainty regarding the number of them that are likely to grow to adulthood. The procedure to be followed for their registration with the authority in charge must be individually agreed upon.



4.2 Transport

Specimens awaiting transport should not be fed for four to five days. Catching and transferring them to their transport containers must be effected with Nitrile or surgical gloves for veterinarian use, but NEVER with latex gloves! An ordinary aquarium dipnet may alternatively be used. Great care must be exercised to avoid injuries to the sensitive skin and gills. Touching the salamanders with bare hands should be avoided.

The salamanders are best transported packed one by one in 0.5-litre plastic containers (wide-necked bottles with an opening of ca. 8–10 cm). If the transit is expected to take a longer period of time or if adult specimens are to be transported, 1-litre containers are recommended. These are filled to half with water from the aquarium in which they used to be kept until then in order to not expose them to changes in water chemistry and temperature. The containers are then stored in a polystyrene box and fixed in place with crumpled paper or bubble wrap as to prevent them from sliding about.

Alternatively, plastic bags may be employed for transport. These are filled to about one quarter with aquarium water and for three quarters with air and firmly closed with rubber bands. They are then treated as described above. NOTE: In contrast to the practices widely employed for transporting aquarium fish, these bags must not be filled with concentrated oxygen as this will “burn” the gills!



Transport begins with catching the Lake Pátzcuaro Salamanders in a circumspect manner (risk of injury!) with a dipnet
| Photo: Benny Trapp / Frogs & Friends



4.3 The Aquarium

An aquarium taking at least 200 litres (e.g., 100-120 x 50 x 40 cm) can accommodate up to five adult *Ambystoma dumerilii*. Two specimens should have a minimum of 80 litres in volume available to themselves, but this is really the absolute minimum. We recommend that the dimensions given above be granted to one pair. Their aquarium should be outfitted with numerous hiding places (e.g., halved earthenware flowerpots), rocks and aquatic plants (live or plastic).

While these salamanders are kept without a bottom substrate at the Viennese Tiergarten Schönbrunn for reasons of hygiene, the tanks of those living in the *Ambystoma Mexicanum* Bioregeneration Center of the Medical Highschool Hannover are furnished with round-grained gravel (natural gravel, not coated) with a granulation of up to 3 mm; as advantages are perceived there that the animals may benefit from finding better purchase, in particular as a slippery biofilm may form easily on glass, and the colonisation of the substrate with nitrifying bacteria. Sand should not be used as a bottom substrate.



Aquaria outfitted with earthenware tubes and plastic plants for sheltering and structuring and aquarium gravel as a bottom substrate | Photos: Christina Liebsch / AMBC



Regular “daylight” fluorescent tubes suffice for lighting the aquaria in otherwise dark rooms; no artificial lighting is required in rooms receiving adequate outside light through windows. Direct insolation must be avoided, though. If artificial sources of light are used, the photoperiod should be controlled to about 12 hours of light per day, varying according to the outside seasons (longer in summer, shorter in winter). Oxygenation of the aquarium water can be ensured via a simple oxygenator (diffuser, air hose). A filter system is recommendable, in particular to as yet inexperienced keepers, but can also be done without if the water is renewed and bottom deposits of dirt are extracted frequently. If a filter is used, we recommend opting for an external one with a slow-current outlet or a mat filter.



Up to five Lake Pátzcuaro Salamanders may be accommodated together in an aquarium with a volume of at least 200 litres
| Photo: Thomas Wampula / Tiergarten Schönbrunn



4.4 Water Chemistry and Temperatures

Water “right from the tap” may be more or less suitable depending on regional particulars. To be on the safe side, the aquarium water should be replaced with tap water that has been left to mature over two days if you are not sure as to how far your fresh tap water is safe to use.

If the salamanders have injuries or suffer from fungal infections, the electrical conductivity of their water may be raised to 1,000 μS for a period of one week by adding iodine-free or saline salt (without anti-caking agents or fluoride). At the Viennese Tiergarten Schönbrunn, these salamanders are kept and propagated in water with a pH of 7.4 and 350–400 μS in conductivity without problems. Considered in conjunction with the values measured in their natural habitat it may be presumed that they do altogether well in neutral to slightly alkaline, moderately hard water.

Water temperatures must be kept within a range of 9–22 °C and must never rise to 25 °C! Values fluctuating between 18 and 22 °C in the summer halfyear have proven favourable. As is the case at the Viennese Tiergarten Schönbrunn, this is best achieved by setting up the aquarium in a cool room that responds to the temperature fluctuations outside so that unnaturally constant conditions are avoided.



Replacing the water: It may be safer to first leave tap water to mature over a period of two days so that can shed its possible load of harmful substances such as chlorine | Photo: Benny Trapp / Frogs & Friends



4.5 Feeding

The Lake Pátzcuaro Salamander has a large mouth that enables it to consume relative large, live prey animals. To this end, it will jerk open its mouth wide and thus create negative pressure that sucks the prey in.

In captivity it can be fed with earthworms and fish of suitable size, including, e.g., smelt, which can be obtained frozen from aquarium supply shops. Provided with such a diet, this species has been maintained and propagated for many years at the Viennese Tiergarten Schönbrunn. Other suitable feeds include chopped chicken heart (but only occasionally), daphnia, Tubifex (must be rinsed before), Enchytraeidae, freshwater shrimp, waxworms (occasionally), and Axolotl pellets.

The animals are fed once or twice per week. To ensure that all specimens receive sufficient amounts of food and to forestall aggressive interactions over food, it is recommended that each individual be fed from tweezers (care must be taken to not cause injuries to the mouth). Squabbles between individuals are more common in juvenile specimens, but adults may also take to fighting over prey, most often resulting in injuries to the feet.

Water quality must be monitored after each feeding session, and a partial exchange of the water may be called for, but this will not normally be necessary if really suitable feeds are used. Leftover food needs to be removed and discarded.



Thomas Wampula feeding earthworms from tweezers, taking care that the salamanders will not injure themselves at its points | Photo: Benny Trapp / Frogs & Friends



4.6 Propagation

The trigger of reproduction-related activities appears to be a period of reduced temperatures in winter and spring. Current knowledge suggests that propagation will be unsuccessful if water temperatures are kept unvarying. Experiences made so far indicate that water temperatures are best left to decrease to below 14 °C in winter before they are raised once more to 14–18 °C thereafter; the salamanders will then normally spawn in April and May.

The specimens kept at the Ambystoma Mexicanum Bioregeneration Center of the Medical High-school Hannover are kept at maximum values of 19 °C in summer and left to cool down to a minimum of 9 °C in winter. Given these conditions, they will usually spawn another time in autumn when their water starts cooling.

The eggs are attached to underwater objects or plants in the aquarium. They should be removed from the tank and placed in separate boxes in which the water is kept lightly oxygenated. Productivity totals about 100-200 eggs per female. The larvae hatch after about two to three weeks, depending on the water temperature.



The eggs are attached to, e.g., the foliage of plants
| Photos: Daniel Zupanc / Tiergarten Schönbrunn



Freshly hatched larvae in an oxygenated incubation box



4.7 Raising the Juveniles

On hatching, the larvae measure 1–2 cm in length. They are kept in plastic containers or miniature aquaria and may be raised in small groups of up to five individuals if their joint tank measures at least 15 x 20 cm. Like the adults, they need to be able to find spots to safely hide away. Their water can be oxygenated simply from a submerged air hose. Juveniles are fairly aggressive amongst each other and biting fights are a distinct possibility. At the *Ambystoma Mexicanum* Bioregeneration Center of the Medical Highschool Hannover, larval and young specimens are for this reason kept one by one in boxes from the point when the nodes of the hind limbs start forming. This also makes it easier to feed every individual with exactly what it is supposed to have. Aggression levels only subside once the young salamanders have grown to ca. 12 cm and it is then that they can once more be kept in colonies in aquaria.

The larvae are fed with artemia, small daphnia and chopped Tubifex during their initial stages of development after hatching (daphnia from commercial sources may sometimes have been raised on yeast, the residues of which carry the risk of bloating in the salamander larvae, for which reason only “yeast-free” daphnia should be used for feeding). On reaching a length of about 5 cm, the larvae gradually become able to also ingest Enchytraeidae, red mosquito larvae, Tubifex and blackworms, and on having grown to some 10 cm, their diet can be expanded to include earthworms and Axolotl pellets. Only high-quality feeds from trustworthy sources should be selected as a matter of principle, lest you may import pathogens, too. Juveniles



A portrait of a larva



A young larva of *Ambystoma dumerilii*
| Photos: Daniel Zudanc / Tiergarten Schönbrunn

should be fed on a daily basis. If they are kept in small containers, replacing their water every day will be of utmost importance! It takes only 4–6 months for juveniles to grow to 10–15 cm in total length.



4.8 Husbandry Challenges

Food particles stuck in the gills may cause fungal infections. To prevent this from happening, leftover food as well as faecal matter should be siphoned off the bottom of the aquarium at regular intervals. Should a fungal infection manifest itself notwithstanding, the electrical conductivity of the water should be raised to 1,000–2,000 μS by adding salt in the manner described above for a period of one week.

Lake Pátzcuaro Salamanders are more inclined to engage in biting fights than, for example, the Axolotl. This applies all the more to larvae and juveniles, which will quite readily attack the limbs of their siblings. In order to curb the extent of this behaviour it is important to richly structure their aquarium. Keeping them one by one (see above) will obviously eliminate the risk of injuries from bites.

Severe bite wounds to the limbs need veterinarian intervention in the shape of an amputation to forestall infections. Limbs lost thus or otherwise are normally completely regenerated.



A Lake Pátzcuaro Salamander with pathogenic changes to the skin (milky discolouration on the head): Problems of this type can often be remedied by salting the aquarium water as described | PHoto: Tim Schikora / Zoo Schwerin



5. Further Reading

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