citizen conservation

#Amphibians

Basic information and care sheet for *Ambystoma andersoni*, Anderson's salamander

As of October 2022 | *Ambystoma andersoni* | Photo: Holger Kraus

Contents

As of October 2022

1. Profile

Scientific name: *Ambystoma andersoni* (Krebs & Brandon, 1984)
Common Names: Anderson´s Salamander (English), Achoque (Spanish), Andersons Querzahnmolch (German)
Snout-to-vent length: 10–14 cm; total length: up to 27 cm
CC#Amphibians-Catergory: III
IUCN Red List status: Critically Endangered (CR)
CITES status (Washington Convention): no
EU-regulation: no
Conservation status in country of origin: Pr (Special Protection) in Mexico
Accommodation: Cold water tank as from 200 liters in cool room without direct sunlight; water temperature 16–20 °C
Essential equipment: Ventilator / filter, hiding places, water plants, water thermometer, gravel washer
Nutrition: Adult animals: Low-protein-pellets, insects, isopods, mosquito larvae, fish; freshly hatched larvae until beginning hindlegs: Artemia; larvae up to 5 cm in length: bloodworm larvae, tubifex, blackworms, Low-Protein-pellets for juvenile animals.

2. What makes *Ambystoma andersoni* a Citizen Conservation species?

Ambystoma andersoni is listed on the IUCN Red List as critically endangered (CR), the highest category of endangerment for animals still living in the wild. Its range is extremely small and limited to a single lake, which suffers greatly from pollution and overexploitation. It borders directly on a residential area and construction activities are planned in spite of a protection zone (Joachim Nerz, written comm.); this is associated with the fear of a deterioration in water quality. Moreover, animals caught by fishermen are probably still used for human consumption, resulting in the realistic risk that Anderson's salamander will be extinct in the wild in the near future.

However, the species can be kept well in aquariums. In the past, animals were repeatedly sold via the pet trade or by private keepers in Europe. They have been kept and bred successfully several times. Their survival in human care is therefore possible and realistic. However, this requires coordination of populations and the establishment of targeted conservation breeding with population management. Such ex situ conservation breeding is strongly recommended for *A. andersoni* by both the IUCN (Shaffer et al. 2015) and biologists who have studied the species (e. g. Valencia-Vargas & Escalera-Vátquez 2021; Zambrano & Huacuz 2012).

However, if breeding in human care is left to chance or uncoordinated keepers, there is a great danger that the animals will disappear from the aquariums one day or suffer from genetic change. Hybridisation is also a major danger. Something similar has happened in the past with other species: First they were abundant in the tanks of enthusiasts and/or zoos, then there was no focus of interest for a while, and finally, unnoticed, they gradually disappeared altogether. Such a development must be avoided at all costs in the case of a highly endangered species like *A. andersoni*. Unfortunately, the populations in aquaria seem to have already declined significantly in recent times; after initially abundant breeding, the species has now disappeared again from many aquaria. (Joachim Nerz, written comm).

This development must be counteracted urgently.

Therefore, Citizen Conservation aims to establish a controlled and coordinated conservation breeding for Anderson's salamander. The goal must be to maintain a population for several decades with the least possible loss of genetic diversity among the source animals available for breeding. Using the scientifically based methods of zoo animal population management, it has been calculated that this will require the establishment of 40 independent husbandries with a total of 225 breeding animals - this is the goal of Citizen Conservation. These husbandries can be accommodated in zoos and aquariums, as well as with private keepers and in other institutions. With such a conservation breeding network, the persistence of the species in human care over the next 40 years would be possible with the least possible loss of genetic variability.

The conservation of a species is a value in itself, even if it only exists in aquaria. Above all, it gives us options for the future. Even if their home waters become uninhabitable for the newts due to progressive negative developments, a later rehabilitation and renaturation would be a thoroughly realistic goal, given the political and social will as well as sufficient time and funds. Then, through conservation breeding projects like Citizen Conservation, animals would be available for possible reintroduction projects. At the same time, knowledge about the species is gathered through keeping and observation in human care, which can also help with species conservation projects on site. Gathering this knowledge is also a goal of Citizen Conservation.

Breeding facility for *Ambystoma andersoni* at NaturaGart-Park Ibbenbüren | Heiko Werning

3. Biology und conservation

3.1 Biology

3.1.1 Classification

The salamanders of the genus *Ambystoma* are widely distributed in North America from Canada to Mexico with currently 26 species (Frost 2021). Some species, such as *A. tigrinum* and *A. mavortium*, inhabit very large ranges mainly in the USA, others are endemic to small regions or even only to individual lakes. Among them is *A. andersoni*, which was recognised and described as a distinct species relatively late in 1984 (Krebs & Brandon 1984). It is closely related to the axolotl (*A. mexicanum*) and is genetically considered its sister species.

Together with the giant salamanders of the genus *Dicamptodon*, the genus *Ambystoma* forms the family Ambystomatidae. It belongs to the order of caudates (Caudata, also called Urodela), which in turn is one of the three orders of amphibians (class: Amphibia).

The well-known axolotl (*Ambystoma mexicanum*) is another neotenous salamander species from the highlands of Mexico
| Lapsis2380 / Shutterstock

The tiger salamander (*Ambystoma tigrinum*) belongs to the same genus as Anderson's salamander, but usually still undergoes metamorphosis and lives on land as an adult
| reptiles4all / Shutterstock

3.1.2 Description

Like its best-known relative, the axolotl (*A. mexicanum*), and the closely related lake Pátzcuaro salamander (*A. dumerilii*), *Amystoma andersoni* is a neotenous caudate. This means that the animals still show larval characteristics after reaching sexual maturity. They are therefore colloquially also called „eternal babies" or „permanent larvae", and in technical language also paedomorphic. Thus, they no longer undergo the complete metamorphosis to a land-dwelling salamander that breathes through its lungs, but live exclusively in the water and breathe through their large external gills and skin throughout their lives. The animals undergo a cryptic metamorphosis, whereby their red blood cells are able to absorb more oxygen.

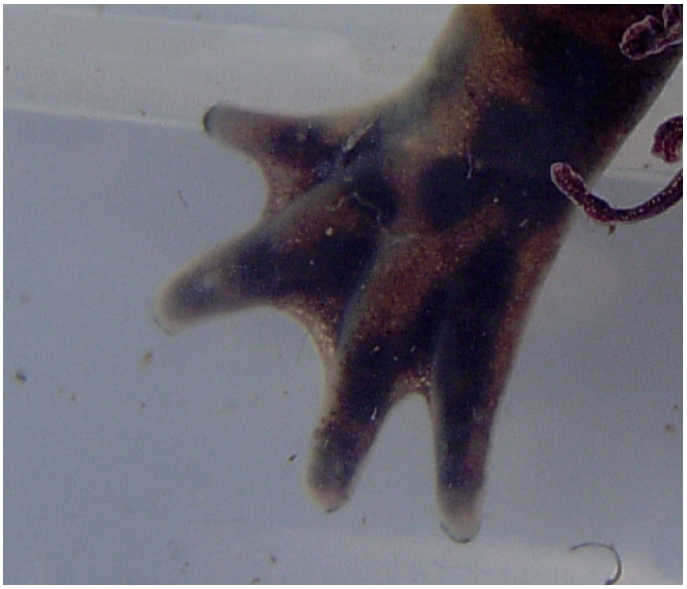
By administering the thyroid hormone thyroxine, metamorphosis can be artificially induced in all species of cross-toothed newts. However, this is legally considered an animal experiment in Germany and therefore requires authorisation. In the aquarium, spontaneous metamorphosis has also been observed in individual cases in *A. andersoni* and other *Ambystoma* species.

What exactly causes this is unclear. It is speculated above all that the diet of the animals can play a role here - such as from food that is too rich in protein or earthworms that have hormone derivatives in their girdle. (Allmeling 2010).

Anderson's salamanders, however, normally retain the typical external shape of a salamander larva throughout their lives, as well as some larval features, such as the external gills. Similar to the axolotl, the animals have a great regenerative power; even severed limbs and parts of the brain can be reproduced.

Anderson's slamander reaches a a length of up to 28 cm
| Wirestock Creators / Shutterstock

The strong, reddish-brown three branches of the external gills on each side of the back of the head protrude radially from the body and are covered with fine, rusty-brown gill filaments
| Christina Liebsch



The fingers on the forefoot of *Ambystoma andersoni* are completely connected by webbing | Christina Liebsch

The Lake Pátzcuaro salamander (*Ambystoma dumerilii*) is a close relative of *Ambystoma andersoni*, lives in nearby Lake Pátzcuaro and is also a Citizen Conservation species | Heiko Werning

Ambystoma andersoni reaches a head-to-torso length of 10-14 cm and a total length of up to 28 cm. The rather massive newts weigh up to 300 g. The body is stocky, deep furrows between the ribs are clearly visible on the sides. The tail is comparatively short, with tail length smaller than head-to-torso length. The tail is enlarged vertically and has a broad swim fringe - typical of a swimming tail. The swim fringe continues on the back to the head.

Arms and legs are short but strong. The toes are completely connected with webbed toes, only their end limbs protrude from them (unlike the axolotl, which has no webbed toes).
Ambystoma andersoni is reddish brown on the head and back. Towards the belly the colouring lightens and changes to yellowish brown. The newt is darkly spotted all over the body. These spots can sometimes flow into each other and form a net-like pattern. There are also animals that are darkly marbled or spotted on a yellow background.

The strong, reddish-brown three branches of the external gills on each side of the back of the head protrude radially from the body and are covered with fine, rusty-brown gill filaments.
The Lake Pátzcuaro salamander (*A. dumerilii*) strongly resembles *A. andersoni*, but is mostly uniformly greenish brown in colour and shows no or only a few dark spots. In addition, *A. dumerilii* grows larger and has a longer tail in relation to the body as well as smaller eyes. The two species also differ in other anatomical details.

3.1.3 Sexual differences

Adult females are often somewhat plumper due to their egg deposits and are rounder when seen from above. Their cloacal glands are small and roundish. In males, the elongated cloacal glands swell considerably with the onset of sexual maturity, especially at mating time, at about one year of age or at a head-to-torso length of about 9 cm. This cloacal bulge is the simplest distinguishing feature.

3.1.4 Distribution and habitat

Ambystoma andersoni lives exclusively in the 220,000 m^2 Laguna de Zacapu, which measures only 600 x 400 m, and in its immediate vicinity in the associated inflows and outflows. (Valencia-Vargas & Escalera-Vázquez 2021). The entire distribution area has a size of only 0.35 km^2 (Shaffer et al. 2015).

The geographical coordinates of the lake are 19°50'N and 101°47'W. It lies at an altitude of 2,000 m above sea level. The lake has an average depth of just under 3 m and a maximum depth of 16 m. Its water is brownish clear, the salinity is low and the electrical conductivity is 150-170 µS/cm. The pH value is 6.4-6.8, the total hardness 3-5° dH, the carbonate hardness 1-4° dH. (water parameters compiled from Allmeling 2010). The water temperature in the lake is relatively homogeneous, there is no stratification; the lake is constantly flowed through due to spring inflows and outflows.

The Laguna de Zacapu is located in the settlement area of the town of the same name with 50,000 inhabitants in the Mexican state of Michoacán. The shore of the lake is peaty and sandy and partly covered with reeds. The south and south-east shores are populated, otherwise agricultural land dominates the shore region.

Air temperatures at the lake vary between 8 and 25 °C throughout the year, water temperatures between 15 and 21 °C. Anderson's salamander lives at the bottom of the lake in dense aquatic vegetation. The lake is wet in summer and dry in winter.

The microendemism - i.e. the occurrence in only one lake - is probably a consequence of the climatic changes in the highlands of Mexico, as are the neoteny and the clustered development of independent Ambystoma species in the waters of the region. (Wistuba 2022; Werning et al. 2021).

As the Mexican highlands became drier over millennia, the ancestors of today's Ambystoma species were forced to live permanently in water and forgo land travel in an increasingly hostile environment. This left the salamanders with only the various lakes of the Mexican highlands as refuges.

Since these are isolated from each other, the populations found there developed into independent species over time - a prime example of evolutionary processes.

The Laguna de Zapacu - the small „town pond" is the only habitat of *Ambystoma andersoni* | Joachim Nerz

3.1.5 Ecology and behavior

Anderson's salamanders are diurnal and relatively lively by axolotl standards. In the Laguna de Zacapu, the animals feed mainly on snails and crustaceans. They also eat fish, their young and eggs, insects and insect larvae as well as worms. The newts mainly stay on the ground and like to hide among the water plants growing there. However, the newts also swim to the water surface at regular intervals and gasp for air there. They prefer richly structured areas of the lake with submerged aquatic plants, floating plants and varied structure and water temperatures of 16-20 °C (Valencia-Vargas & Escalera-Vátquez 2021).

Compared to axolotls (*Ambystoma mexicanum*) and Lake Pátzcuaro salamanders (*A. dumerilii*), Anderson's salamanders are relatively well tolerated by each other, both as adults and as larvae at all stages.

Ambystoma andersoni can be expected to live for about 20 years.

Anderson's salamanders are quite active swimmers | Christina Liebsch

3.2 Conservation

On the IUCN Red List, *Ambystoma andersoni* is listed in the highest endangerment category for wild species as „critically endangered" (Shaffer et al 2015). Johnson et al (2017) list the species in the highest prioritisation for conservation action as „Priority One: High Vulnerability Species in a Single Physiographic Region".

The reason for the endangerment is, on the one hand, the naturally small distribution area and, on the other hand, the progressive environmental pollution, biotope destruction and hunting within this tiny area. *Ambystoma andersoni* lives exclusively in the Laguna de Zacapu and its immediate surroundings in its inflows and outflows. Its populations are declining (Shaffer et al. 2015).
The main cause of the endangerment is the increasing water pollution, mainly from agriculture, urban and industrial wastewater, as well as the use of the lake located in the urban area as a local recreation area. An intensively used swimming area is directly connected to the water body. These influences lead to a deterioration of the water and biotope quality, while Anderson's salamander depends on clean water.

Another problem is the use of the locally well known animals for human consumption. Even though they are officially protected, they continue to be fished, according to consistent recent observations (Shaffer et al. 2015; J. Nerz, written comm.).

An additional threat could be the past release of predatory fish through direct predation pressure or competition.

Ambystoma andersoni is protected in Mexico (category Pr, „special protection" in Mexican species protection law). Its habitat has been protected as an „Área Natrual Protegida", i.e. as a nature reserve, since 2003, and in 2005 part of it was also declared a RAMSAR site of international ecological importance for wading birds and waterfowl, yet actual conservation measures, action plans or management plans for the species are still lacking.

Awareness of the precarious situation of the lake and its salamanders does exist locally.
In 2012, Joachim Nerz (written comm.) observed a demonstration against the construction of a new hotel directly on the shore of the lake.

As a conservation measure, the World Conservation Union IUCN and biologists propose, in addition to the protection and rehabilitation of the lake, breeding in human care in order to have animals available that can be reintroduced there after a quite possible rehabilitation and the implementation of effective conservation measures (Shaffer et al. 2015; Valencia-Vargas & Escalera-Vátquez 2021; Zambrano & Huacuz 2012).

This goal is also pursued by Citizen Conservation, which is why the species was included in our programme in 2022.

Demonstration at the Laguna de Zapacu against a planned border development there and for the protection of *Ambystoma andersoni* | Joachim Nerz

Without conservation breeding in the aquarium, *Ambystoma andersoni* is at risk of extinction in the near future | Joachim Nerz

4. Care

The information on care and breeding in our recommendations is based to a large extent on experience at the NaturaGart-Park Ibbenbüren (Kraus, written communication), the Schönbrunn Zoo in Vienna and Christina Liebsch, as well as on Allmeling (2010).

Show facility through portholes for *Ambystoma andersoni* in the NaturaGart-Park Ibbenbüren | Heiko Werning

4.1 Requirements and duty of documentation

Ambystoma andersoni is not protected internationally. There are no official reporting obligations or restrictions on keeping.

Participants of Citizen Conservation must report their stock of animals to the CC office at regular intervals in accordance with the valid placement contract. This is usually done twice a year (on 1.3. and 1.9. of the year). Participants will be reminded by the CC Office to submit the report.

Further requirements result from CC's general guidelines and the placement contract. In particular, it should be noted that the animals and their offspring are property of CC and remain in the programme or are marketed centrally by CC. Before breeding offspring, it should be briefly discussed with the CC office whether there will be a need for offspring in the programme in the foreseeable future in order to avoid accommodation problems.

4.2 Transport

The animals should not be fed for four to five days before transport. Catching and transferring is done with nitrile or veterinary gloves (never use latex gloves!). Alternatively, a commercially available aquarium landing net can be used, but be especially careful, otherwise there is a risk of injury to skin and gills. Handling with bare hands should be avoided.

Transporting neotenous salamanders such as the axolotl albino shown here or Anderson's salamander can be done well in fish transport bags filled 1/4 with water and 3/4 with air | Napat Chaichanasiri/Shutterstock

For transport, it is recommended to pack the animals individually. For this purpose, use 0.5 litre plastic containers (wide-mouth containers) with an opening measuring approx. 8-10 cm. For adult animals or longer transports, it is better to use one litre containers. These are filled halfway with water from the aquarium in which the animals were previously kept, so that the water chemistry and temperature remain stable. The containers are packed in a polystyrene box and fixed with paper or bubble wrap so that they do not slide around. Alternatively, fish transport bags can be used for transport. These are filled one quarter with water and three quarters with air and then tightly closed with rubber bands. The rest of the procedure is as described above. Attention, unlike usual for fish, the bags must not be filled with highly concentrated oxygen, this leads to gill necrosis and skin irritation.

4.3 The tank

In order to keep Anderson's salamander, you need a tank that is as spacious as possible. According to the keeping guidelines of the DGHT-AG Urodela, to calculate the minimum floor space required for two animals, take the total length of one of the newts in cm and multiply it by 0.01. The resulting figure gives the floor space in square metres. This means: For two 25 cm long *A. andersoni* you would need at least a tank floor space of 0.25 m^2 (25 x 0.01 = 0.25). This would correspond to a tank with a base area of 80 x 30 cm. For a pair, an 80 cm long, commercially available 80 litre tank would therefore be considered the lowest, just acceptable size. According to these care guidelines, the floor space must be increased by 25 % for each additional animal.

Allmeling (2010) recommends always choosing a tank length of at least 80 cm. For 5 animals she suggests a 200-240 litre tank with 100-120 x 40 x 50 cm. Citizen Conservation recommends at least these dimensions for groups of 2-5 animals. At NaturaGart-Park Ibbenbüren, the breeding group of five A. andersoni lives in a 200 x 70 x 70 cm tank. In tanks that are too small, the danger of biting each other is much greater, especially when the animals are hungry and snatch at anything that comes to their mouths.

The tank should only be filled with water up to about 10 cm below the rim and should have a cover or at least an inner glass edge, as the fast newts may well jump out of the water.

The tank should be richly structured with hiding places (e.g. halved clay pots, tubes, caves), stones and water plants (real or plastic). If plastic products are used, they must not contain plasticisers. It is better not to use wood, as it tends to rot in the long term or serves as a colonisation surface for parasitic protozoa, to which the newts react sensitively.

Nymphaea mexicana (Mexican Water Lily), *Najas guadelupensis* (Nixweed) and *Vallisneria spiralis* (Common Water Screw), planted out or in a clay pot, have proven to be suitable as living aquatic plants; they grow well under the conditions and are sufficiently robust. Allmeling (2010) also recommends water fern, java fern, java moss, hornwort, cabomba, water pennywort, spring moss, moss balls and Echinodorus.

Sharp-edged furnishings should also be avoided so that the newts do not injure the tips of their toes or webbed feet.

Fine gravel (under 3 mm grain size) or sand under 1 mm grain size can be used as substrate. Coarser gravel should not be used because there is a risk that the newts will pick it up when sucking and too large stones will cause problems. Bad experiences have been made with keeping newts without a substrate; it seems to lead to fungal infections of the feet (Kraus, written comm.).

Low lighting is sufficient (above the room, LED strips or weak fluorescent lamps). Bright light is not liked by the newts, so direct daylight into the tank should be avoided. The lighting time can be about 8-14 hours a day or simply equal to our day length. It should vary accordingly over the course of the year.

The water in the tank should be well aerated (live water plants, aerators). A filter ensures permanently clean water. Kraus (written comm.) recommends commercially available external filters. Allmeling (2010) recommends the use of the Hamburg mat filter. Partial water changes are carried out as required.

The fresh water should have the same temperature as the aquarium water and be filled in slowly so as not to panic the animals.

Tank for *Ambystoma andersoni* in the exotarium of Zoo Frankfurt/Main | Johannes Köhler

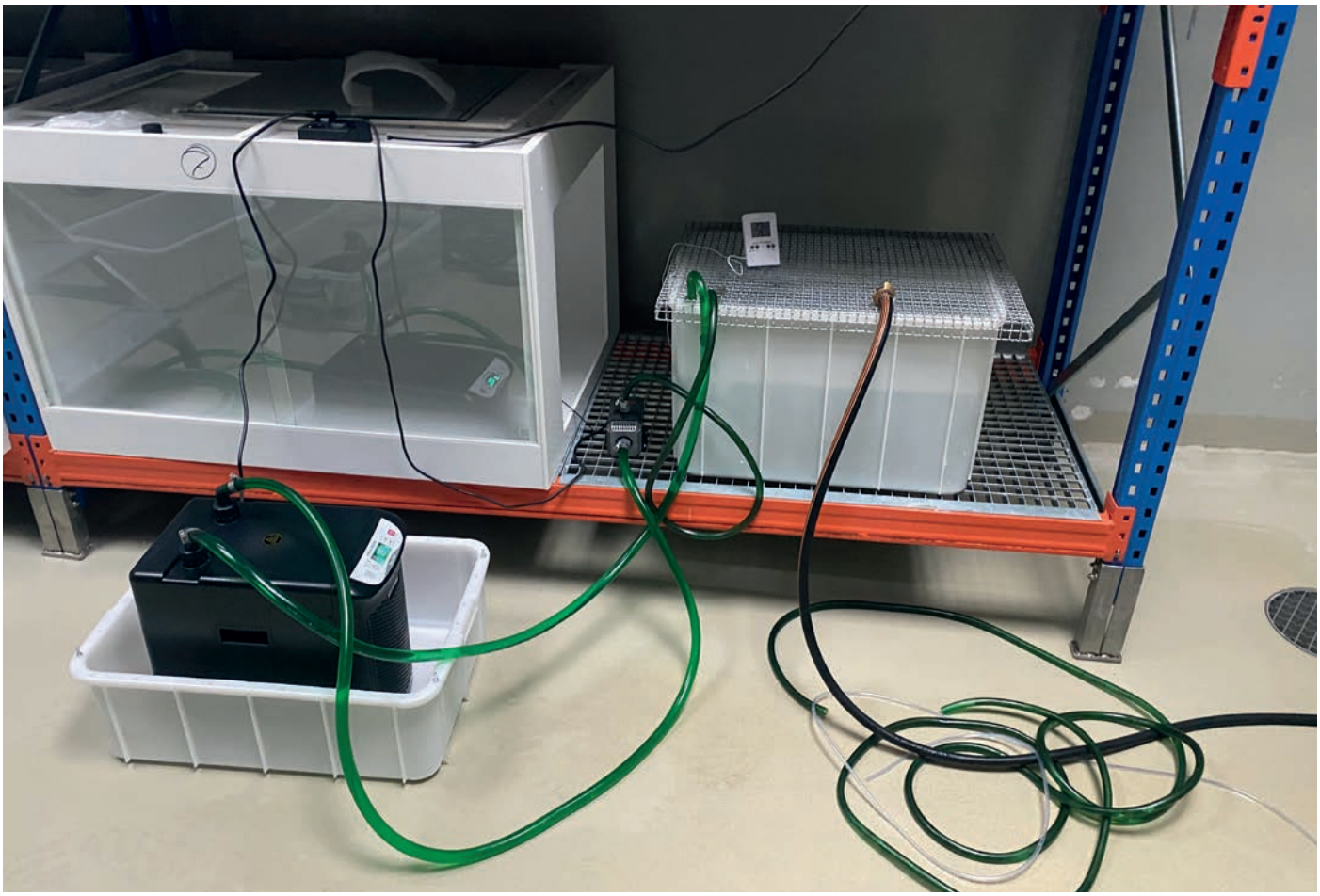
Sand can be used as substrate, aquatic plants provide cover in the tank | Johannes Köhler

Stones can be used to create burrows for the animals; however, they must rest firmly on the ground slab and must not be able to be knocked over or undermined | Heiko Werning

4.4 Water chemistry and temperatures

Values between 16 and 20 °C are recommended as the „standard water temperature". In the NaturaGart-Park Ibbenbüren, Anderson's newts are kept at water temperatures of 10-22 °C; they fluctuate during the day and year with the outside temperatures. The temperature should never rise above 24 °C, even in summer, not even for a short time. If necessary, water cooling must be used if correspondingly low values cannot be guaranteed at the location of the tank.

In the NaturaGart-Park Ibbenbüren, the pH value is 7.6-8.2, the total hardness 5° dH, the carbonate hardness 4° dH and the conductivity 90-280 µS/cm (at present, they are kept there at 150-170 µS/cm). Allmeling (2010) recommends a pH value of 6.8-7.5 and 4° dH total hardness. According to her, the nitrite content should be below 0.5 mg/l; if this value is exceeded, a partial water change should be carried out immediately.



With such a water cooler (in the picture front), the water temperature can be kept in the desired range | Johannes Köhler

4.5 Feeding

Feeding pellets, as used in salmon farming and sometimes also offered for axolotls („Low Protein Pellets", e.g. from Aquaterratec), have proved successful. Raw freshwater fish, freshwater mussels, mosquito larvae, but also live small fish such as guppies, insects, isopods, crayfish, freshwater snails etc. are also readily eaten. The fat content should be as low as possible; therefore, the enchytraea, which are readily taken but contain a lot of fat, should only be offered carefully.

„Low protein pellets" for feeding *Ambystoma andersoni* | Heiko Werning

Anderson's salamanders mainly eat food that has sunk to the bottom or is swimming past directly in front of their mouths. The adult newts should be fed 1-2 times a week. Kraus (written comm.) gives two feedings per week with „low protein pellets" as a guideline for the amount of food when keeping in 16-20 °C warm water; about 5-10 pellets of size 4-5 mm per animal and feeding are added to the tank. The amount of food may vary with changing conditions such as temperature fluctuations.

The pellets spoil and become mouldy quickly, so nothing should be left lying around. This should always be checked. If food is left over, it should be vacuumed up afterwards.

As a „reserve", small fish or freshwater snails can also live permanently in the tank; the newts then capture one of the animals every now and then as a snack for in between.

4.6 Breeding

Changes in water temperature or lighting can serve as mating triggers. Courtship often takes place at the beginning of the year or in summer, usually after the water temperature has been lowered. Often the newts also get into a mating mood on their own due to the changing conditions with the seasons. Otherwise, it can be deliberately triggered by temporarily keeping them in a cooler environment.

Mating is triggered by the female secreting a pheromone. The male's cloacal area then swells visibly. He courts the female by approaching and head-butting her and finally deposits a spermatophore, which is then actively taken up by the female with the cloaca. A female can also pick up spermatophores from several males. The seeds contained in the spermatophores lead to fertilisation of the eggs inside the female's body. They can also be stored by the female in a sperm pocket for several months, only to be used for fertilisation later. Normally, females start laying eggs 12-24 hours after picking up the spermatophore. The eggs (several hundred can be laid) with a diameter of a good 2 mm are applied to water plants, stones or other furnishings directly with the cloaca on the respective substrate; the female holds on to the substrate with her hind legs.

With Citizen Conservation, the animals and their offspring remain the property of the project. This is necessary for a coordinated breeding project. Therefore, before rearing eggs, please contact the CC office to clarify whether or how many offspring can later be given away or mediated. Otherwise, the eggs should not be incubated, but removed from the tank (e.g. by suction with a hose) and disposed of.

Gelege von *Ambystoma andersoni* | Holger Kraus

4.7 Rearing offspring

If incubation is desired, the eggs are best transferred to smaller containers with 16-19 °C water and an aerator. At warmer temperatures, the hatching larvae are usually too weak. A colder incubation is possible successfully, but takes much longer. At the recommended temperatures, the still legless larvae hatch from the eggs after 9-20 days with a size of approx. 12-13 mm. They should be placed in groups in small containers with a low water level. With regular (every 1-2 days) water changes, further aeration or filtration is not necessary. Attention, the larvae react very sensitively to metals or chemical additives in the water.

In the first two days, the hatchlings lie on the ground and still feed on their yolk sac. Only then do their mouths open. Initially, the larvae only eat moving, very small food, such as freshly hatched, watered Artemia nauplii, water fleas, cyclops or small plankton. Water fleas from the trade in particular must be watered for several days before feeding, because otherwise the newt larvae may be gassed up or become fungal due to the commercial diet. Initially, the larvae should have practically unlimited food at their disposal and should therefore be fed daily. Dead Artemia must be removed. After the front legs have become visible, the larvae's sense of smell has also developed. Now dead food is also accepted, such as thawed red mosquito larvae. Tubifex, shiner worms and red mosquito larvae are also eaten alive. The larvae can also be transferred to a normal tank if they eat without problems and in a controlled manner. However, it is safer to keep them in boxes until they are about 10 cm long. Only then is their immune system stable, and feeding can be more targeted when they are kept in boxes.

When the hind legs are visible, larger live food - such as stream fleas, freshwater shrimps, shiner worms, insects - as well as freshwater fish and the food pellets already mentioned above can also be offered.

Up to a total length of about 10 cm, the larvae are still fed daily. They are then about three to four months old. Up to 15 cm, they are fed about every three days, then only once or twice a week as described above.

Young *A. andersoni* reach sexual maturity with a head-to-torso length of about 9 cm. Depending on feeding and temperature, they are then about one year old.

Unlike *Ambystoma dumerilii*, the larvae of *A. andersoni* seem to be more compatible in all stages and can also be kept in groups, provided they do not vary greatly in size and are well fed. Hungry larvae snatch at everything they come across and can thus quickly inflict injuries on their conspecifics. If you want to raise as many larvae as possible, keeping them individually at the size stage between 4.5 and 12-15 cm is safest (Kraus, written comm.).

Larvae aged three weeks and 2 cm long | Holger Kraus

The larvae can be reared in small groups in plastic boxes | Holger Kraus

Young larvae with already developed forelegs | Christina Liebsch

Adolescent animals in the rearing tank | Heiko Werning

Adolescent Anderson's salamander | Heiko Werning

Adult offspring | Johannes Köhler

Ambystoma andersoni in a quarantine tank
| Johannes Köhler

4.8 Problems

Permanently high water temperatures above 22 °C lead to an increased susceptibility of the newts to infectious diseases and fungal infections. The skin, gills and gastrointestinal tract are particularly affected.

Slight fungal infections of the skin can be treated by short baths in iodine-free salt solution for about 20 minutes.

A common cause of disease is overfeeding. Anderson's salamanders like to snatch, and many keepers therefore tend to feed the animals too frequently. However, feeding every three days is sufficient.

While no metamorphoses are known from nature, they occasionally occur in aquarium care. There is evidence that they are induced by diet. There may be an increased risk if young animals are fed earthworms before reaching sexual maturity, which should therefore be avoided. (Allmeling & Fleck 2009; Allmeling 2010). For the same reason, no other amphibian larvae or tadpoles should be fed; these contain elevated thyroxine levels before metamorphosis, which in turn can trigger metamorphosis in *A. dumerilii*. An excessively rich diet or suboptimal water values are also suspected of being able to trigger metamorphosis.

If metamorphosis occurs, the animals are very susceptible to stress and skin diseases during this phase. The metamorphosis is first seen in an indentation in the swimming fringe at the root of the tail. Subsequently, the swim fringe gradually recedes on the back, leaving a small groove. Eyelids form. The animals now straighten their heads more often and hold their noses out of the water. Only when the swimming fringe has largely disappeared do the gills also retract. Now the almost „ready" salamanders try to leave the water. During this time they no longer eat. There are clear changes to the head and the skin, and the colouring also changes. The entire metamorphosis takes three or more weeks.

Metamorphosed salamanders live on land on the ground. They can be kept in a terrarium with humus and moss as substrate, in which they like to hide. They only need a small water part or a corresponding water bowl, which they only visit occasionally, especially for moulting. They feed on live feeding insects, which they do not actively wait for, but ambush. They are now nocturnal. However, according to previous experience, metamorphosed *A. andersoni* are quite decaying (Shaffer et al. 2015).

5. Further reading

Allmeling, C. (2010): Zur Haltung und Entwicklung des Andersons Querzahnmolch *Ambystoma andersoni*. – elaphe 3-2010: 30–38.

Allmeling, C. & J. Fleck (2009): *Ambystoma andersoni*, Pflege und Zucht. – Aquaristik Fachmagazin 41(3): 78–83.

AmphibiaWeb (2022): *Ambystoma andersoni*. – https://amphibiaweb.org, University of Berkeley, CA

Frost, D.R. (2021): Amphibian Species of the World: an Online Reference. Version 6.1 (Abruf am 6.6.2022). – attps://amphibiansoftheworld.amnh.org, American Museum of Natural History

Heimes, P. (2001): Die Querzahnmolche Mexikos. – Aquaristik Fachmagazin 33(4): 7–13.

Johnson, J.D., L.D. Wilson, V. Mata-Silva, E. García-Padilla & D.L. DeSantis (2017): The endemic herpetofauna of Mexico: organisms of global significance in severe peril. – Mesoamerican Herpetology 4(3): 514–620.

Krebs, S.L. & R.A. Brandon (1984): A new species of salamanders (family Ambystomatidae) from Michoacan, Mexico. – Herpetologia 40(3): 238–245.

Shaffer, HB., D. Wake, G. Parra-Olea & O. Flores-Villela (2015): *Ambystoma andersoni*. – In: IUCN Red List of Threatened Species. – http://www.iucnredlist.org/details/59051

Valencia-Vargas, R. & L.H. Escalera-Vátquez (2021): Abundancia de la salamandra *Ambystoma andersoni* con relación a la dinámica estacional y heterogeneidad espacial en el lago de Zacapu, Michoacán, México. – Revista Mexicana de Biodiversidad 92: e923283. https://doi.org/10.22201/ib.20078706e.2021.92.3283

Werning, H., K. Theobald & P. Wagner (2021): Die Rettung der Wassermonster – das Beispiel *Ambystoma dumerilii* im Programm Citizen Conservation. – elaphe 2021-6: 24–38.

Wistuba, J. (2022): Axolotl. – 5. Auflage, Natur und Tier - Verlag, Münster, 104 S.

Zambrano, L. & D. Huacuz (2012): Conservation genetics of threatened Mexican axolotls (*Ambystoma*). – Animal Conservation 15: 61–72.