citizen conservation

#Amphibians

Basic Information and Husbandry Guidelines for *Salamandra salamandra almanzoris*, Almanzor Fire Salamander

Issued: 23.02.2019 | *Salamandra salamandra almanzoris* | Photo: Philip Gerhardt

Contents

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1. Characterisation

Scientific name: *Salamandra salamandra almanzoris*
Vernacular names: Almanzor Fire Salamander, Gredos Fire Salamander
Total length: to ca. 19 cm in the terrarium; specimens in the wild are typically smaller and more delicate
CC #Amphibians category: III, suitable also for newcomers to CC #Amphibians
Threat status according to IUCN Red List: none
Threat status according to CITES: none
Threat status according to EU Species Conservation Ordinance: none
Threat status according to Bundesartenschutzverordnung: Annexure 1
Threat status according to Bundesnaturschutzgesetz: under particular protection
Threat status in its native country's Red List: "Vulnerable" (VU)
Accommodation: Terrarium with an aquatic section or water bowl
Equipment required: Terrarium with secure lid, aquatic section or water bowl, feeding tweezers, misting bottle.
Feeding: Earthworms, crickets, slugs of appropriate size, feeder pellets

2. Why is *Salamandra salamandra almanzoris* a Citizen Conservation species?

The Almanzor Fire Salamander is exclusive to a relatively small region in the high mountains of central Spain. The small size of its insular distribution is the major reason why it is categorised as "vulnerable" in the Spanish Red List. Even though this subspecies is fortunately not immediately threatened by habitat destruction at present the populations trends for fire salamanders in Spain are negative in general. A particularly severe threat could arise from the salamander-eating fungus Bsal. If it were to infiltrate the small populations of the Almanzor Fire Salamanders, this subspecies would possibly be threatened in its continued existence very quickly.

Other diseases, like the chytrid fungus Bd and Ranavirus, must be regarded as further threats that render establishing a captive reserve population in human care sensible. Added to this is that the Almanzor Fire Salamander is particularly well suited for being kept in terraria and therefore makes for a good study object in environmental-pedagogic education as well as for acquiring experience in the captive keeping and breeding of fire salamanders with the aim of enlarging the numbers of qualified keepers for the conservation breeding of immediately endangered subspecies or populations.

3. Biology and Conservation

3.1 Biology

Philip Gerhardt sexing fire salamanders | PHoto: Benny Trapp / Frogs & Friends

The Almanzor Fire Salamander is one of about 14 subspecies of the fire salamander, Salamandra salamandra. Within the order of the tailed amphibians (Caudata) it forms part of the family of true salamanders (Salamandridae). The Almanzor Fire Salamander is a mountain-dwelling subspecies that is home to the central Spanish mountain ranges Sierra de Gredos, Sierra de Guadarrama, and Sierra de San Vincente where it occurs at altitudes of up to 2,000 metres and above. This exposes these salamanders to a particularly distinct annual rhythm that will see them becoming active only late in the year, that is, from May/ June, and their annual activity period is comparatively short. The natural habitats of the Almanzor Fire Salamander are bare of trees and marked by grasslands that are interspersed with granite boulders and small accumulations of water. As is typical of fire salamanders, the female will give birth to live larvae in a pond – which is unique amongst tailed amphibians. Owing to the high-altitude climate, these larvae will spend two or three winters in the water, grow to total lengths of 8–9 cm, and even develop their distinct yellow and black colour pattern before they eventually metamorphose and go onto land. In the wild, the Almanzor Fire Salamander has strictly nocturnal habits.

Laguna Grande de Gredos, a locality of *Salamandra salamandra almanzoris* | Photo: Philip Gerhardt

The Almanzor Fire Salamander is one of the smaller subspecies of the fire salamander, with free-ranging specimens not normally growing larger than around 13 cm. In the terrarium, on the other hand, specimens have a potential of reaching total lengths of up to 19 cm. The tail length does not quite match the snout-vent length. Compared to other fire salamanders, this subspecies is marked by a reduced yellow pattern that will often consist only of large yellow dots on the pitch-black ground colour. This may be interpreted as an adaptation to the cool habitat conditions of the high mountains, in the manner also observed in the Alpine salamander (Salamandra atra): A black colouration absorbs more solar energy. The males are smaller and slimmer than the females, but they often have wider heads, and their cloaca will be puffed up during the mating season. Fire salamanders are long-lived animals, with some specimens having lived to an age of 30 years and the present longevity record standing at a staggering 50 years.

3.2 Threats

The fire salamander is currently not considered threatened with extinction on a global scale, and it is classified as "Least Concern" in the Red List of the International Union for Conservation of Nature (IUCN). Its populations are nevertheless on the decline.

The subspecies *Salamandra salamandra almanzoris* has a very small and insular distribution range, which is enough for its being included as "vulnerable" in the Red List of Spain.

Amphibians are particularly susceptible to alien diseases like the chytrid fungus Bd and Ranavirus. The fire salamander has over the past few years been encountering a particularly severe threat that may have dramatic consequences for many of its populations: A new fungus was discovered in 2013 that was aptly dubbed the salamander-devouring fungus, or scientifically expressed, *Batrachochytrium salamandrivorans*, usually referred to by the abbreviation Bsal.

Highly contagious, fire salamanders infected with it will usually perish within a short space of time, and it can wipe out entire populations. This is exactly what has happened repeatedly in the border triangle of The Netherlands, Belgium and Germany. Such a scenario would be catastrophic for a subspecies with an extremely small distribution range such as that of the Almanzor Fire Salamander.

If Bsal were to be introduced to its populations, it could well mean its end. This is one of the reasons why stable reserve populations should be established in human care where they can be effectively protected against infections with Bsal and other pathogens. Citizen Conservation #Amphibians therefore is particularly focused on epidemic control.

3.3 Conservation Efforts

A portion of the natural habitat of the Almanzor Fire Salamander is legally protected in the Sierra de Guadarrama National Park. Information boards pointing out the occurrence of this rare animal have been erected at the Laguna Grande de Gredos.

An information board at the Laguna Grande de Gredos points out the exclusivity of the Almanzor Fire Salamander in this region | Photo: Philip Gerhardt

4. Captive Husbandry

Almanzor Fire Salamanders have been kept and propagated in private collections for decades. As far as zoological and scientific installations in the German-speaking parts of Europe are concerned, the official list of zoo animals shows that it was kept only in the Dresden Zoo prior to CC #Amphibians entering the scene.

The husbandry information provided here is based for the largest part on the experiences made by Uwe Seidel and Philip Gerhardt.

Philip Gerhardt and Uwe Seidel posing in front of their "salamander boxes" for the systematic propagation of fire salamanders | Photo: Benny Trapp / Frogs & Friends

4.1 Restrictions and Documentation Requirements

An internationally valid protection status for this subspecies does not exist. In Germany, *Salamandra salamandra almanzoris* falls under the legal protection of a particularly protected animal afforded by Annexure 1 of the Bundesartenschutzverordnung (Federal Species Conservation Ordinance) like all other fire salamanders. Specimens kept, all changes to the captive population like cases of death, captive-produced young, and specimens passed on to other keepers, therefore have to be registered with the Untere Landschaftsbehörde.

This usually requires that a photocopy of the certificate of origin from CC #Amphibians be submitted. Every change to the population kept must be given notice of in writing to the CC #Amphibians Office (a simple E-mail will do) and the authority in charge within four weeks. The authority in charge must also be notified of any specimens that are transferred by mediation of, or returned to, CC #Amphibians. Registration of captive-bred specimens with 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 a week prior to the planned move. This will prevent them from soiling their transport containers with faeces. Fire salamanders, both adult and juvenile specimens, are transported one by one as a matter of principle, each in a plastic container of adequate dimensions and furnished with ventilation holes. These containers need to have securely closing lids that in cases of doubt may be additionally fixed in place with sticky tape. A proven transport medium is moderately damp Sphagnum moss of the kind available dried and neatly packed from commercial sources. The salamanders need to be able to bury themselves in the substrate when they feel overly stressed. This is facilitated by filling their transport boxes with this substrate for some 75 %. The moss may be much damper than it would be under normal terrarium conditions. Transporting on moist kitchen towels instead has caused many problems in the past as it motivated stressed salamanders to incessantly cruise their containers in search of a shelter and saw them dying in the end, possibly to due exhaustion. Live moss from the forest should never be used as a transport substrate. At a time when the chytrid fungus Bsal continues to spread in nature, using such moss harbours the risk of introducing this lethal infection to terrarium populations.

The containers with the individually packed salamanders are then stored together in a thermostable box (polystyrene). In fact, they must never be transported without one or just openly in the car or in a bag! The polystyrene box provides protection against abrupt temperature fluctuations and may need to be cooled in summer by adding bottles filled with cool water from the refrigerator (5 – 6 °C). Temperatures inside the box should be monitored with a remote-sensor thermometer.

NOTE: It would be utterly foolish to use frozen cooling elements in such a polystyrene box! They would cause temperatures to drop so low that the salamanders may die of freezing.

Changes of ownership within CC #Amphibians are preferably effected person to person. If the animals need to shipped, animal welfare laws stipulate that this must be left to a certified logistics company specialising in this type of transport. Shipping live animals in this manner should not be attempted during periods of extreme weather (frost or high summer temperatures).

Larvae should be transported only if there really is no alternative. They are much more sensitive and need to be moved individually in an adequate amount of cooled water (see the more detailed chapter "Transport" in Seidel & Gerhardt 2016).

4.3 Composing a Colony

A perfect scenario for propagation purposes is keeping one male together with one female (1.1) or one male with two females (1.2). Individuals in a larger colony may prove compatible, but this situation may also cause stress to some or all specimens. The males are particularly prone to feel stressed by the presence of other males; they will then engage in combat rituals and possibly exert too much pressure on the females present. So-called "all-male groups", i.e., more sizeable colonies of males, may work out, though. For their part, juveniles may be raised together in larger groups to the point of their reaching sexual maturity, but it will be sensible to sort them by body size.

4.4 The Terrarium

Housing 2–3 specimens necessitates a terrarium with a ground surface area of 80 x 40 cm, but 100 x 50 cm would be better. The terrarium should be outfitted with generous ventilation surfaces secured with mosquito mesh, and stagnant air must be strictly avoided.

A view into a naturalistic terrarium for housing fire salamanders; this type of husbandry makes perfect ventilation and a maximum of hygiene obligatory | Photo: Philip Gerhardt

4.5 Placement, Temperature Management, Terrarium Technology

The terrarium should be set up in an unheated room that must not face south. Overheating is a constant risk, especially in summer, that must be monitored closely and forestalled by placing the tank away from spots that could be reached by sunlight falling in through windows! Normal room temperatures are entirely adequate for keeping these salamanders during their active phase of the year. Maxima of maybe 26–27 °C in summer are tolerated for brief periods of time, but only if nightly values will then be significantly lower! Temperatures should in general decrease at night, and keeping values constant cannot be recommended for this subspecies from the mountains. If temperatures are elevated, stagnant air and dampness must especially be avoided at all costs!
These salamanders need to hibernate. They are best overwintered in a cool basement room where they will be exposed to 4–12 °C for 2–3 months. Values should not fall short of the minimum limit of 4 °C, though. The salamanders must not be fed during this period. Overwintering them individually in plastic containers in a refrigerator is entirely feasible.
NOTE: Constantly low temperatures around 10–12 °C, as is recommended in more dated literature, are counter-productive. Fire salamanders also need periodically higher values to uphold their metabolic functions. It is therefore much more sensible to expose them to temperatures that will fluctuate with the course of each day in summer, which means palpably lower values at night.
The lightness of a normal room with windows suffices for keeping fire salamanders, considering in particular that these animals are nocturnal anyway. Additional lighting may of course be employed for aesthetic reasons in display tanks, but then lamps should be used that will not emit additional heat, e.g., LEDs.

Almanzor Fire Salamanders may be overwintered in boxes like these | Photo: Philip Gerhardt

4.6 Outfitting the Terrarium

An important aspect of keeping fire salamanders is choosing the right bottom substrate for their terrarium. A fundamental consideration is that it must not be conducive to accumulating their metabolic end products (faeces), as this would inevitably lead to health issues! Furthermore of importance is that Almanzor Fire Salamanders require rather a dry environment. Their substrate may even be "desert-like" in character, because the salamanders will cover their need for moisture by bathing in their water bowl at night. High levels of substrate moisture or even "wet" conditions will inevitably cause skin problems.

Maximally hygienic husbandry on newspaper, with shelters, a water bowl complete with exit ramp, and a wet box | Photo: Uwe Seidel

A proven technique for systematically propagating them is by keeping them on newspaper. This seemingly unnatural "floor cover" consists of cellulose, which is exactly what the salamanders live on in nature as well. Newspaper is easily replaced, hygienic, and always available. Newspaper here explicitly refers to the type of paper used for ordinary newspapers and not to that of full-colour printed magazines or promotional material. Misting is entirely done without in their tanks!

Pieces of cork bark laid out on tiles and offering hollow spaces beneath make for perfect shelters. A wet box filled with damp Sphagnum moss is readily accepted as a temporary hiding place and most beneficial to keeping the salamanders in good health in the long run. It is of great importance that they will be able to choose between "moist" and "dry" situations according to their requirements fully on their own all the time. A water bowl with an exit ramp completes the simplistic outfitting. This type of husbandry is purely functional and designed to keep the salamanders healthy by satisfying all their biological needs, and to facilitate their reproduction, even if it may convey the impression of laboratory accommodation. While the aesthetic value of such a tank is rather limited, keeping the animals thus has proven highly successful. Considering that the project CC #Amphibians is all about propagating a certain species while simultaneously fulfilling its biological needs, this must be the recommended type of husbandry.

Naturalistic terraria are of course an option: Shown here is a display tank for native fire salamanders in the Schwerin Zoo | Photo: Zoo Schwerin

If the salamanders are to be on display – be it in a zoo or other public places or in private quarters where aesthetic aspects play a role – the husbandry concept of a paludarium may be entertained. This type of enclosure can be set up so that the salamanders can be seen even during the day by incorporating their hiding places into the rear wall against the glass pane of, for example. A natural bottom substrate commonly used in this scenario is compacted and dried loam.

It should be kept really dry as well, and faeces have to be removed at regular intervals. This bottom substrate also requires replacement after a certain period of use and it will of course be a much more involved affair than in the case of newspaper. Many keepers recommend exchanging natural substrates at about yearly intervals (if, as was pointed out before, hygiene is treated as a matter of priority).

Alternative bottom substrates: Loam... | Photo: Michael Fahrbach

...and foam rubber | Photo: Philip Gerhardt

An alternative to loam is bentonite. This clayey mineral is available practically everywhere in the shape of cat litter. It has attributes similar to loam, but is far more easily sourced. Other natural bottom substrates include forest, potting or peaty soils. These soils must be entirely free of fertilisers. They have to be replaced at regular intervals as well, which may turn out relatively labour-intensive if you maintain several terraria. A positive attribute is that they well support destruent organisms such as earthworms, woodlice, and, in particular, springtails. With its acidic pH, peaty soil has an antibacterial effect, but it must be viewed as problematic with regard to nature conservation. All natural bottom substrates should be arranged at a decline to the front as to create a moisture gradient along which the salamanders can find the optimal spot at any given point of time.

Other optional artificial bottom substrates for a salamander terrarium are foam rubber or filter mats. Filter mats are manufactured for use in aquarium filters and as such can be used without reservations after they have been rinsed thoroughly. Conventional foam rubber, on the other hand, may be questionable because it may contain chemical softeners. If you opt for filter mats or foam rubber, either should be laid out as to cover the entire bottom pane of the terrarium save for one corner.

The tank is then filled with water to a level of about 1–2 cm (depending on the thickness of the material; it should be at least 3–4 cm). The open corner will thus automatically form an aquatic section in the terrarium. The bottom substrate is kept clean by adding fresh water and extracting the old water from the open corner. This will flush the filter mats or layer of foam rubber at regular intervals. One advantage of this strategy is the ease of bottom moisture control, and springtails survive quite nicely in the mats, too. In spite of regular flushing this type of husbandry is in general more conducive to the proliferation of bacteria and germs that will find adequate survival conditions in the pores

of the material. However, it is particularly well suited for outfitting the nursery boxes of juveniles, as they need more moisture than adult salamanders. A small nursery box is also easily placed in a sink for more thorough flushing, which will be done quickly and very practical when it comes to larger numbers of boxes that require being treated thus.

Various keepers swear by others approaches and keep their salamanders, e.g., on forest moss or a bedding of gravel. All these concepts certainly have their pros and cons, and every keeper has to find his or her own ways of doing things by taking guidance from the major biological requirements of the animals: Although moisture must be accessible at all times (water bowl or section, damp spots, wet box), the bottom substrate must be rather dry, and hygiene is of utmost importance!

Using live plants is often a difficult undertaking and is not even a must for the keeping of fire salamanders; it is therefore merely a question of aesthetics that you will have to find answers to only in the case of display terraria. While live plants need some moisture in their substrate if they are to thrive, it is exactly that which must be avoided for the sake of the salamanders. If you thought of using flowerpots for the plants, you will soon find that the salamanders love to bury themselves in these at times. If you feel there just has to be some "green" in the tank, you may want to consider high-quality imitation plants and avoid all these problems. They are also easily cleaned and even disinfected if the need arises.

Keeping salamanders on a natural bottom substrate with a multitude of shelters | Photo: Philip Gerhardt

4.7 Feeding

Fire salamanders are carnivorous both at larval and adult stage, i.e., they feed on other animals. Fully-grown specimens are most conveniently fed with crickets and earthworms, which are commercially available, and as a special treat will visibly enjoy a snack of freshly collected slugs of appropriate sizes.

They may also be fed with feeder pellets for aquatic chelonians. These pellets are first soaked in water and then offered from tweezers. Furthermore fit for use as non-live feed is "Grub Pie" from the manufacturer of terrarium animal feeds, Repashy. The advantage of this pellet feed is its being enriched with minerals and vitamins, and even though their composition has been designed for turtles, it will also be fit for use with salamanders. Like the former, the latter are prone to suffer from metabolic bone diseases such as rickets if they are undersupplied with these substances.

As a matter of principle, adult salamanders are fed every 10–14 days and juveniles at weekly intervals. The animals should always be a little hungry when food is made available and accept it right away. Live prey animals should always be "gut-loaded" before they are offered to their end-consumers, meaning that the feeder animals should for their part have been fed well before; they should furthermore be dusted with a high-quality vitamin/mineral powder (see also the chapter "Feeding in the Terrarium" in Seidel & Gerhardt 2016).

Salamanders have adapted to feeding only on days when the weather allows them to venture out and forage for prey. Feeder animals should not be left to roam the terrarium for longer than a day or two, and this applies in particular to crickets.

Worm chops dusted with a vitamin/mineral powder are offered on a piece of kitchen towel (here: *Salamandra algira*)
| Photo: Uwe Seidel

Uwe Seidel feeding salamanders from tweezers
| Photo: Benny Trapp / Frogs & Friends

4.8 Propagation

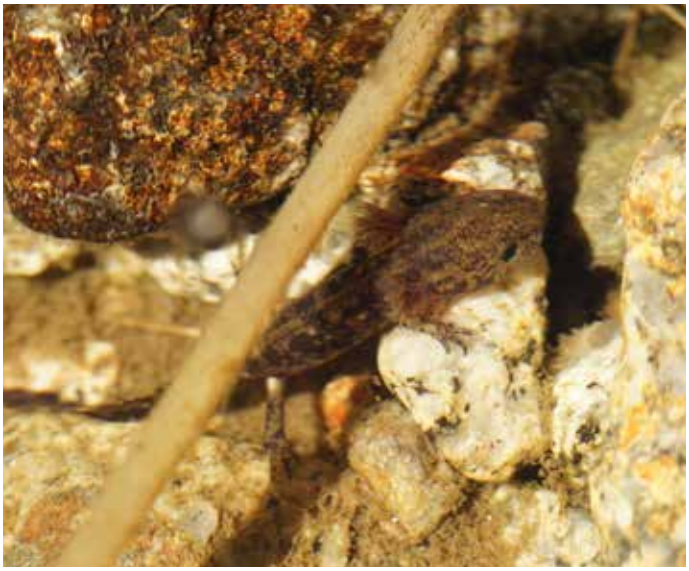
Mating activities may be induced in Almanzor Fire Salamanders when the summer weather outside is right (thunderstorm or decreasing barometric pressure) and you lightly fog up their terrarium with a plant mister. The moisture added thus should have evaporated after 2-3 hours, though. Fire salamanders mate on land, with the male depositing a spermatophore during the course of a ritualised courtship display. The female will then pick up this sperm packet with her cloaca for subsequent internal fertilisation of her eggs. Mating may be observed throughout the year if only the weather is right.

Fire salamander give birth to fully formed larvae (larvipary), which is, as has already been pointed out, a unique mode of reproduction amongst tailed amphibians. The larvae will by then have developed in the body of their mother and exit their "eggshells" during the birthing process. Thereafter they will be entirely independent and capable of hunting, quite in contrast to larval newts that will first pass through a stage of being attached to some underwater object during which they will resorb what is left of their yolk sacs. Salamander larvae do not have such reserves and therefore need to find food rather quickly.

Almanzor Fire Salamanders may produce up to 30 or even as many as 40 larvae at a time, depending in the size and age of the female. These are released during the period of activity, mostly in spring and summer.

Freshly released salamander larvae | Photo: Uwe Seidel

4.9. Raising Juveniles



A larval fire salamander in the Laguna Grande de Gredos
| Photo: Philip Gerhardt

Philip Gerhardt checking on nursery tanks
| Photo: Benny Trapp / Frogs & Friends

Being inhabitants of headwaters and high-altitude streams, the gill-bearing larvae respond very badly to polluted water. Raising them therefore makes it obligatory that their water be replaced frequently and/or that there is an effective filter system in place.

A well-functioning nursery installation that will keep maintenance work at a minimum is detailed in Seidel & Gerhardt (2016). The larvae have distinct cannibalistic tendencies and will inevitably consume each other should there be a shortage of food. It is for this reason that only larvae of about the same size should be kept together, and there must always be enough food for all.

The duration of larval development strongly depends on water temperatures. Providing values of 15–20 °C is ideal, with the larvae then requiring between 8 and 12 weeks to reach a stage at which they will metamorphose.

The larvae of *Salamandra s. almanzoris* tend to take longer than those of other fire salamanders to reach this point of time, and some of the larvae of a year will hibernate and as a result continue to grow to surprising sizes of up to 10 cm.

It is entirely normal that not all larvae reach the stage of metamorphosis. Weaker runts are regularly predated upon by their stronger siblings. This is a biologically normal process that ensures that only the fittest juveniles will grow up.

The larvae are fed with thoroughly rinsed Tubifex, Enchytraeidae or even with finely chopped earthworms, all of which are feeder animals that can be obtained as regular aquarium fish feeds from the pet shop. Leftover food has to be removed before it can spoil the water.

On approaching metamorphosis, the baby salamanders must have available an easily scaled exit from the water in order to prevent them from drowning. If need be, they can be transferred to a metamorphosis container that has been jacked up at one end. Once they have gone onto land, they are raised further on a diet of small crickets and chopped-up earthworms; this does not normally pose a problem. Freshly metamorphosed fire salamanders need to be kept in a significantly moister ambience than adults for their first few weeks on land.

Very large larvae short before their metamorphosis | Photo: Uwe Seidel

4.10 Husbandry Challenges

Routinely checking on all specimens is important | Photo: Benny Trapp / Frogs & Friends

A damp or even wet environment or compromised hygiene inevitably lead to skin problems that will be difficult to treat. Shortcomings in the supply with minerals and vitamins cause rickets-like manifestations that will be almost impossible to rectify.

Fire salamanders are escape artists that can be kept only in well-secured terraria! Specimens that have managed to leave their tanks into your living quarters are often difficult to track down and will quickly die of desiccation. It must by all means necessary be ensured that no Almanzor Fire Salamander has a chance of escaping into the wild (risk of faunal alienation and the spread of alien diseases).

Intraspecific stress is likely to compromise the immune system and will render salamanders more susceptible to disease. It is therefore crucial to compose colonies with great care and deliberation (see chapter 4.3 above).

5. Further Reading

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