

Basic Information and Husbandry Guidelines for *Alytes muletensis*, Mallorcan midwife toad





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1. Characterisation

Scientific name: *Alytes muletensis* (SANCHIZ & ADROVER, 1979)

Vernacular name: Mallorcan Midwife Toad, Balearic toad

Length: 3.5-4 cm

CC#Amphibians category: IUCN Red List: Endangered (EN)

Protection status CITES (Convention on International Trade in Endangered Species): no

Protection status on European level: Annexes II and IV of the Habitats Directive

Housing: Preferably in groups of six animals or more in terrariums of approx. 80 x 30 x 40 cm (length x width x height) with mineral substrate (gravel etc.), many hiding places (layered cork bark, stone slabs etc.) and a removable water bowl with low water level. Moist and dry hiding places.

Temperature range 15-25 °C. Year-round indoor keeping without real hibernation (winter temperatures in the lower range of the temperature range).

Diet: All common food animals up to the size „cricket medium“ are eaten (crickets, fruit flies, waxworms, isopods etc.).

Even small toadlets can eat small crickets etc.

Breeding: Reproduction possible all year round, peak in the summer half-year. Clutches are wrapped around the legs of the males and carried until the tadpoles hatch. Rearing of the tadpoles in aquaria with approx. 1-2 tadpoles/L without further technical equipment. Feeding with fish food, brewed nettles etc. Long larval phase of up to 18 months, tadpoles then very large.





2. Why is *Alytes muletensis* a Citizen Conservation species?

In the beginning, there were a few fossil bones. When scientists B. Sanchíz and J. A. Alcover described the toad *Baleaphryne muletensis* after finding these remains of a Middle and Upper Pleistocene amphibian from the Balearic island of Mallorca in 1979, they assumed that the species had been extinct for about 2,000 years.

The surprise was all the greater when, in 1980, researchers on an expedition to the site where the bones were found in the Serra de Tramuntana came across lively representatives of these amphibians. And that in the middle of the much-traveled vacation island Mallorca! The Mallorcan midwife toad can stand symbolically for our highly incomplete knowledge about amphibians. Surprises can never be ruled out, while at the same time we have to fear that many species are actually becoming extinct, sometimes even before we have discovered them.



Pastor and nature photographer Ole Dost is CC's godfather for the Mallorcan midwife toad



This threat is also symbolized by the Mallorcan midwife toad. The distribution area of the species today is only about 10-20 km² - species with such small areas must basically be considered endangered, since a single catastrophic event could wipe them out. The fact that this toad can only be found in such a small area is already the result of human influence and thus typical for an important cause of endangerment of amphibians:

Alytes muletensis used to be widespread on Mallorca, but was probably pushed back in ancient times by new species introduced by humans: on the one hand, by the viperine snake (*Natrix maura*), which is an effective predator, and on the other hand, by the Iberian water frog (*Pelophylax perezi*), which also eats Mallorcan midwife toads, but also competes directly with them.

The remaining habitat is threatened by extensive agriculture and human settlement. Another threat is the recently introduced chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*).

The International Union for Conservation of Nature (IUCN) now classifies *Alytes muletensis* as „endangered“ (EN).

It therefore makes sense to keep a reserve population in human care, to fall back on in case of emergency - such as a dramatic population collapse in the wild.

Alytes muletensis, like all midwife toads, exhibits spectacular reproductive biology and can thus provide an example of the fascinating variety of unusual amphibian reproductive strategies. Male Mallorcan midwife toads wrap eggs strings around their hind legs, carry them around until the tadpoles hatch, and release the hatching larvae into a suitable body of water. Through this highly developed brood care they increase the survival chances of their offspring enormously.

Finally, the Mallorcan midwife toad is a charismatic, easy-to-observe and easy-to-keep species, making it well suited for keeping by less experienced persons or for school vivariums, and therefore can serve as an ambassador for both the diversity of amphibians and their global threat situation.



3. Biology and Conservation

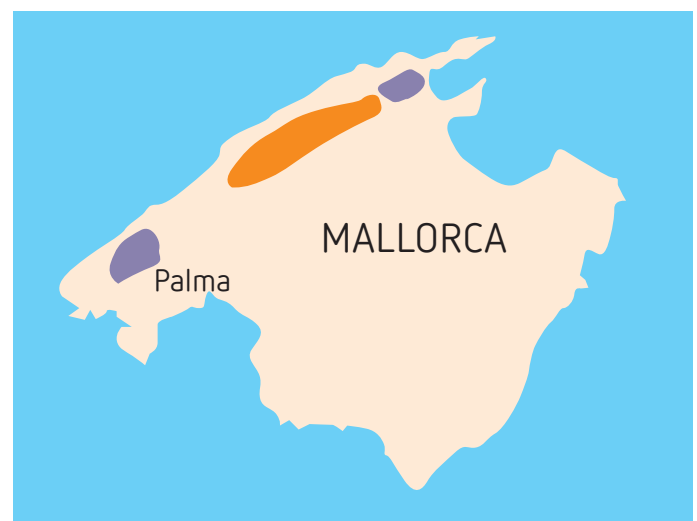
3.1 Biology

Midwife toads of the genus *Alytes* occur in six species in the Mediterranean region. They belong to the family Alytidae together with the *Discoglossus* and *Latonia*. *Alytes muletensis*, with a length of about 3.5-4 cm, is the smallest and least bulky midwife toad. Its body structure seems rather frog-typical: its legs and fingers are longer than those of other midwife toads, the head is large and rather strongly flattened. The sexes in *Alytes muletensis* cannot be distinguished with certainty externally outside the reproductive phase. Pregnant females are more plump, and the ovaries may sometimes be visible. Males carry eggs strings after egg laying. In general males are somewhat slimmer, females are slightly larger on average.

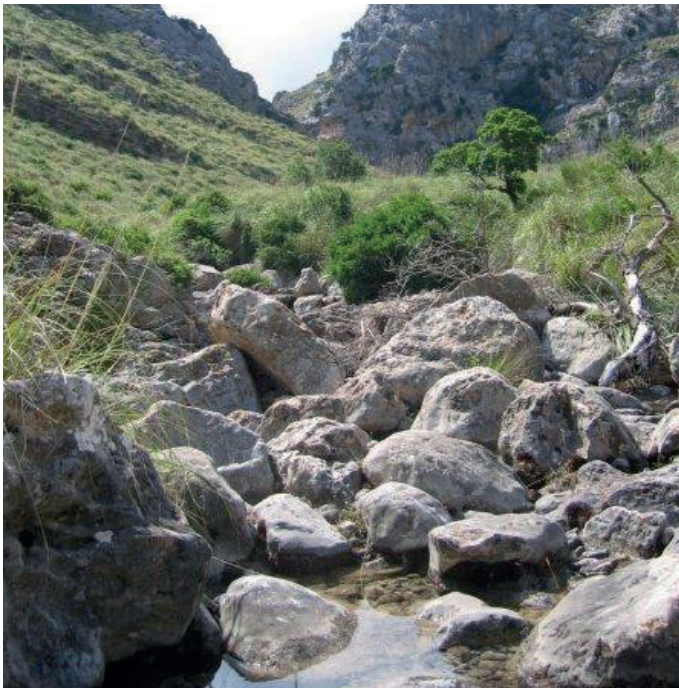
The large eyes with vertically slit pupils are conspicuous in the Mallorcan midwife toad. Its basic coloration is cream to yellowish with darker, greenish-black to brown „leopard spots“. There is sometimes a black triangular marking behind the eyes. The ventral side is whitish and without markings.

Today *A. muletensis* only occurs in a ten square kilometer area in the Serra de Tramuntana in the northwest of Mallorca. There the species inhabits 30-70 meter deep rocky gorges at elevations between 30 and 850 meters above sea level. Torrents flow through these gorges, which dry up in summer except for small pools. These permanent pools are critical for larval development. However, midwife toads also use artificial water bodies in the vicinity of the the gorges. The adult animals live in crevices, caves or under stones of the the karst mountains and are usually not seen, but only heard in the wild.

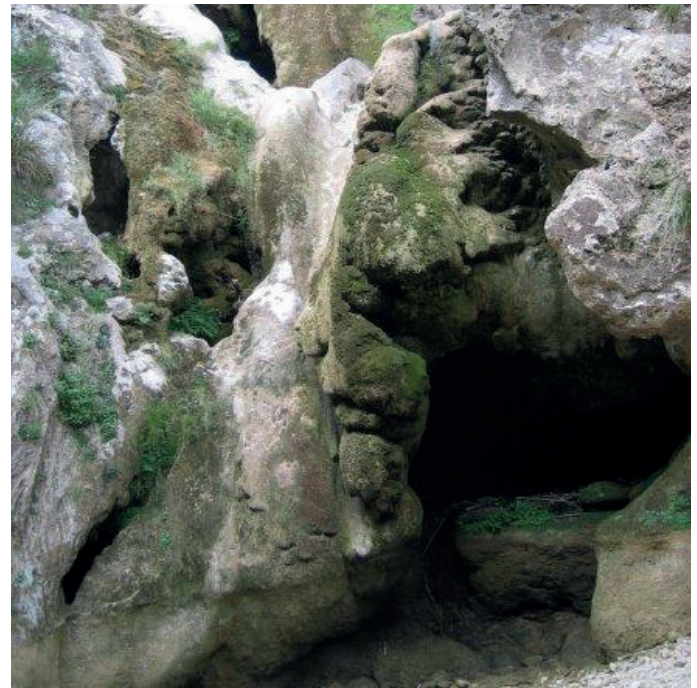
The small toads are mainly nocturnal.



Distribution of *Alytes muletensis* in Mallorca according to the IUCN Red List: The remaining original habitat is colored orange, the purple areas mark reintroduction areas.



Habitat in Mallorca | Foto: Dawn Flemming/Durrell Wildlife Conservation Trust



Mallorcan midwife toads live in the crevices of these rocky gorges | Foto: Dawn Flemming/Durrell Wildlife Conservation Trust

Breeding in Mallorca takes place between February and September. In February, the males begin to call. This „frog concert“, often compared to a chime, stimulates the females to form eggs. Calling also serves as a form of territorial behavior. Males „mark“ their preferred calling sites. When another male approaches, especially if a female is present, the competitor is decisively pushed out of the way.

Females also call in response to males, to initiate mating, and in disputes with conspecifics over mates. When there is a surplus of females, females also make display calls to attract attention (BUSH 1997).

The reproductive behavior of midwife toads is unusual. All midwife toads engage in intensive brood care that is unique among amphibians. Egg-laying takes place on land, usually in May for *Alytes muletensis*. To do this, the animals go into amplexus, where the male clasps the female by the loins.



During oviposition, the male fertilizes the eggs with his sperm and then wraps the egg strings, which contain 7-34 (usually 10-12) eggs with a diameter of 5-7 mm, in a complicated procedure around the hind legs, where they are „tied up“ in the area of the thighs. In the process, the male sometimes pulls part of the egg string straight out of the female. This process is similar in all *Alytes* species and is responsible for the name „midwife toad“. The scientific genus name also refers to this unusual specialization: „alytos“ in Greek stands for „tied up“. The egg strings are extremely tear-resistant when out of the water, and with the eggs inside, they look like strings of pearls.

In the beginning the eggs are yellowish to white but soon one can already see the two dark spots that mark the eyes of the larva. The male carries the eggs, which become darker and darker as they develop, for about 3-4 weeks (reports range from 11-65 days), during this time it retreats to damp places to prevent the eggs from drying out. However, it can also mate with other females during this time and also take their spawn. From June onwards, the male goes to a body of water where the connections of the egg strings soften in the water and finally dissolve. The male assists his self-release by vigorously kicking with his hind legs.

The tadpoles break through the egg shell and then swim away. They are just under 2 cm long at the time of hatching. Now it takes another 2-3 months for larvae hatched early in the year and growing up under favorable climatic and food conditions, and 12-18 months for larvae hatched later and growing up under cool temperatures or meager food resources until metamorphosis. With a length of about 5 cm, the hind legs are well developed. The larvae eventually reach up to 8 cm in length, making them among the largest tadpoles in Europe.

Interestingly, the tadpoles can react individually to the invasion by viperine snakes. If the snakes are on the move in the water, the tadpoles not only develop faster, but their tails also become longer, have less pronounced fin seams, but stronger muscles. Chemical messengers from the viperine snakes are detected by the tadpoles as well as the toads and trigger avoidance behavior.

Metamorphosis is associated with shrinkage - the fully developed young toads end up measuring only about 2.5 cm and weigh about 0.6-0.7 g.

The life expectancy of the Mallorcan midwife toads is usually 5-8, but sometimes up to 10 and possibly even up to 18 years (PINYA & PÉREZ-MELLADO 2013).



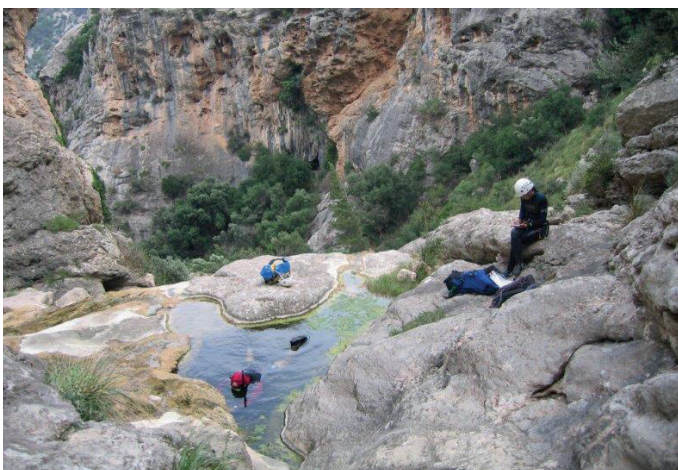
3.2 Threat Situation and Protection

Of the original distribution area on the island of Mallorca, only a small remaining habitat of 10 km² was inhabited by *Alytes muletensis* when the toads were discovered in 1979. Due to the protection and reintroduction measures, the distribution area increased considerably.

According to IUCN estimates, approximately 500-1,500 adult pairs lived in the wild in 2020. However, even the small remaining habitat is not securely protected: Channelization and water withdrawals are altering streams and the region's water balance. The biggest problem is probably water pollution from settlements and livestock. Tourism and construction activities further aggravate the situation. Finally, the problem with viperine snakes and Iberian water frogs remains topical. Presumably, these two invaders are mainly responsible for the fact that the originally much larger distribution area has already melted down in ancient times to the small refuge in the Serra de Tramuntana, where it is simply too cool for the newcomers. But climate change could prove to be another threat: If it gets warmer, the two invaders may be able to spread into the mountain gorges as well.

Due to the critical situation, an ex-situ breeding program and a reintroduction of captive-bred midwife toads was started as early as the 1980s with the support of the Mallorcan government and nature conservation organizations and zoos, led by the Durrell Wildlife Conservation Trust based on the English Channel island of Jersey.

In 1985, the first 20 animals were taken from the wild and then bred in a terrarium. Other zoos and institutions joined the program, including Barcelona Zoo and Wilhelma Stuttgart.



Researchers from the Durrell Wildlife Conservation Trust examine a pool with tadpoles | Foto: Dawn Flemming/Durrell Wildlife Conservation Trust



View of rearing terrariums for Mallorcan midwife toads in Jersey Zoo greenhouse. | Foto: Matt Goetz/Durrell Wildlife Conservation Trust

In 1989 a reintroduction program was started. Thousands of tadpoles and young toads were released over the next few years in localities that had historically been part of the distribution range of *A. muletensis*, but where the species had disappeared in the meantime. For this purpose, artificial spawning waters were also created in the form of troughs with sheet pile walls. As a further measure, viper snakes were trapped and removed from habitats of *A. muletensis*.

With success: BULEY & GONZALES-VILLAVICENCIO (2008) report that 25 localities of the species are known, 12 of which are due to reintroduced animals; the range was almost doubled by the reintroduction project. 25% of the wild population is thought to be descendent from reintroduced animals.

Unfortunately, in the early years of the reintroduction project, the danger posed by the chytrid fungus *Bd* was not yet known. The fungus was only discovered in 1998 and scientifically described in 1999. In 2004, dead *A. muletensis* on Mallorca tested positive for *Bd*. Genetic tests proved that the fungus must have been introduced into the habitats from Jersey via the reintroduction project. As a result, further reintroductions were stopped. Currently (2020), new reintroduction measures are being prepared under tightened biosecurity conditions.

Despite the setback caused by the chytrid fungus, the IUCN reports an increasing population trend due to reintroductions, but at the same time the threat situation remains serious, so that the species has undergone a rather lively change in Red List categories: In 1990 it was assessed as „endangered“ (EN), in 1996 it was listed as „critically endangered“ (CR), in 2004, due to the success of the reintroduction program, it was assessed as „vulnerable“ (VU), and in 2020 was again classified as „endangered“ (EN).

The Mallorcan midwife toad currently seems to be able to live with the fungus in its natural habitat. Whether this will remain like this in the event of an increase of environmental stress, for example as a result of climate change, remains to be seen.

In any case, due to the fragile situation caused by the very small habitat on the one hand and the many possible threats on the other hand, it is urgently indicated to maintain and expand a coordinated reserve population in human care.



CC proof of origin

4. Husbandry

4.1 Conditions and Documentation Requirements

Since *Alytes muletensis* is „strictly protected“ in Germany according to the Federal Nature Conservation Act, keepers must immediately notify the responsible authority of their population and any change in population. This notification must be made by the keepers, i.e. those who have the animals in their care, irrespective of the owner. For Citizen Conservation participants, this means that although the animals are the property of the project, keepers must report their animals to the authorities on their own responsibility. With their signature on the „Species Protection Appendix to the placement contract“, they assure that they will comply with this obligation. Citizen Conservation requests a copy of the notification and/or confirmation of notification from the authorities for our records. Also offspring or releases have to be reported to the authority immediately.

In Austria all amphibians have to be reported. In the „Minimum requirements for keeping anurans,“ *A. muletensis* is not specifically listed. For *A. obstetricans*, 1,200 cm² of floor space is required for the first animal and 200 cm² for each additional animal. This would equate to 3,400 cm² for 12 animals, or approximately 80 x 40 cm of floor space.

Independently of this, CC participants agree to report their stock to the Citizen Conservation Office every six months on 1st of March and 1st of September. This report is currently made by mail using a form and will be possible in the future via the login area of the CC website (www.citizen-conservation.org). This will include the opportunity to report observations and experiences in keeping and breeding the species or to submit photos, as one of the goals of CC is to increase knowledge of our project species. The photos can be used by CC for internal purposes and public relations for the project (e.g. social media) free of charge.

For CC keepers the guidelines of the project apply, the acceptance of which was signed with the placement contract.

When passing on CC animals to other keepers, the animals must be accompanied by a certificate of origin or a breeder's certificate. Forms are available from the CC office. The transfer (also of offspring) is only permitted after prior consultation with the CC office. If owners want to give away animals (also offspring), please inform the CC office as soon as possible, so that new owners can be found.



4.2 Transport

a) Tadpoles

Due to the *Bd* problem of *Alytes muletensis*, the transfer of tadpoles to new keepers is only possible under certain circumstances in direct consultation with the CC office, as this may require further veterinary examinations.

The tadpoles of *Alytes muletensis* are robust and can be transported without problems. They should be transported in watertight containers 30 – 50% filled with water or equivalent to ornamental fish in plastic bags, which are appropriately secured, e.g. in a heat-insulating styrofoam box. The temperature during transport should be between 10 and 25 °C.

b) Metamorphosed animals

Metamorphosed toads can be easily transported in small plastic containers with air holes, either individually or in small groups, depending on the size of the container. The containers should be equipped with some damp kitchen paper or moss and placed in a protective outer packaging (e.g. styrofoam box). A temperature range of 10-25 °C during transport is not suitable.

The animals must be protected from greater heat or cold.

Transport within CC is ideally done by personal pickup. Alternatively, a courier service certified for transporting live animals may be contracted. Information on this can be obtained from the CC office.



Tadpoles can be easily transported in plastic containers or bags | Foto: Philipp Ginal



4.3 Socialization

Mallorcan midwife toads are peaceful among themselves and like to live sociably. Since the sexes can hardly be distinguished visually, it is recommended to keep a group of 8-12 animals together.

The space requirement is low, and this way the probability is high that males and females are represented in sufficient numbers. If there are too few males in the group, it can happen that they are harassed and stressed by the females. You can react to this by keeping egg-carrying males individually - ideally the other animals should rather be taken out of the terrarium and moved, because disturbances can lead to the male stripping the eggs.



The small toads like to live socially and can be kept well in groups of around ten animals | Foto: Philipp Ginal



4.4 The Terrarium

The demands of this species on the terrarium are low. Standard glass terrariums are suitable, but plastic terrariums or boxes work as well. Sufficient ventilation areas in the lid or sides are important. It is important to make sure that the enclosure is tightly closed, because Mallorcan midwife toads can climb well even on vertical surfaces.

For a group of 12 adult animals CC recommends a terrarium size of 80-100 cm x 30-40 cm x 40 cm (length x width x height). Of course, there is nothing against larger terrariums. The height can be used by the toads if the walls are structured accordingly.

Different substrates can be used. Gravel, pumice gravel or dolomite gravel mimic the natural habitat well. Dried clay is also suitable as a terrarium substrate.

Furnishings are essentially layered stone or slate slabs, hollow pieces of cork bark, perforated bricks, clay bowls, or the like, so that there are sufficient hiding places into which the toads can retreat. The animals prefer narrow hiding places with body contact to the „ceiling“.

When installing stones/stone slabs, it is essential to ensure that they are firmly in place and cannot wobble or slip, in order to prevent accidents. They must also not be placed in such a way that the toads can squeeze into gaps not able to free themselves.



View into a fully furnished terrarium | Foto: Philipp Ginal



Stone structures, mineral substrate and a water basin are the core furnishing items | Foto: Sergé Bogaerts



Other structural elements such as roots, pieces of bark or live plants can be added as desired. Terrarium moss also serves well as a furnishing item as well as a moisture reservoir.

All furnishings should be disinfected before being placed in the terrarium, e.g. by heat treatment (e.g. one hour at 60-80 °C in the oven), especially to prevent the introduction of the chytrid fungi *Bd* or *Bsal* from the wild/outside.

Mallorcan midwife toads occasionally like to visit the water, also to replenish their own water reserves. However, they are not good swimmers. A large water bowl is sufficient; the water level should be high enough for the animals to float in, but only high enough so that they can always touch the ground with their hind legs. A good guideline is a container with a capacity of about 1-2 liters (e.g. commercially available ice cream can). It must be possible for the animals to leave the bowl without any problems (e.g. by placing a stone in the water).

The back and side walls of the terrarium can be designed as rocky walls as desired, so that the movement space for the toads that like to climb is increased even more.

In the summer months it is also possible to keep the toads in an outdoor terrarium; this must be well secured against intruders from outside (predators, danger of introducing chytrid fungi) as well as overheating or flooding.



The little toads like to hide under hiding places like these brick slabs; here, spacers made of Styrofoam are used to create a comfortable „ceiling height“ | Foto: Uwe Seidel



Removable water bowl with stone as exit aid; the toads also deposit their eggs here | Foto: Uwe Seidel



4.5 Lighting, Temperatures, Humidity

The Mallorcan midwife toad is quite easy to care for - the technical effort required is minimal. The keeping at room temperature is possible without any problems.

The animals thrive well in a temperature range of 15-25 °C, also higher or lower values are tolerated for a short time (but the values should not fall below 15 °C for extended periods). Seasonal and day-night variations are recommended.

In the experience of many keepers, a simple fluorescent lamp or an LED lamp is sufficient for the terrarium lighting and to provide a day-night rhythm. The lighting duration can be roughly oriented to the actual conditions outdoors. Some keepers also dispense with special lighting altogether and use natural daylight. Strong solar radiation into the enclosure must be prevented at all costs to avoid overheating.

Other keepers (WELLS et al. 2015), on the other hand, emphasize the importance of a UV component in the lightspectrum and therefore recommend the use of UV-emitting fluorescent lamps. It should be noted that there should be no glass between the lamp and the animal, because UV light is filtered out by glass.

The reach of UV fluorescent lamps is not large, so that the enclosure must not be very high, depending on the type used, or the animals must have the opportunity to climb close to the lamps by means of stones, back walls, etc., in order to be able to use the UV component. The successful and long-term breeding of the species is also possible without UV-light. The terrarium, besides dry places, must always have moist places and water available (see point 4.4, „The Terrarium“).

To maintain the required humidity gradients, occasional spraying and refilling or watering of a part of the terrarium (e.g. around the water bowl) is sufficient. Keeping the terrarium too humid is problematic and leads to an increased risk of infection, so it is important that part of the terrarium is kept permanently dry.



The keeping is possible without problems even at room temperature and does not require much technical effort

| Foto: Uwe Seidel



4.6 Feeding and care

Mallorcan midwife toads are also pleasingly uncomplicated when it comes to feeding. They will overwhelm all common live feeders of suitable size, e.g. crickets, waxworms, woodlice, „buffalo worms“, etc. Adult toads cope with crickets of the commercial size „medium“. But smaller food is also readily taken.

Young toads can already be fed with crickets of commercial size „small“, but they also take other small food (e.g. *Drosophila*). Adult Mallorcan midwife toads should be fed about once a week, and several times a week during the peak activity period in spring and summer. It is important to make sure that all animals can get enough food. As a rough guideline you can calculate 4-5 medium crickets per week and animal. Well-fed animals can go without food for 2-3 weeks without any problems. If kept in a cooler environment in winter, the toads are still fed weekly.

All live food should have been fed a high quality diet before feeding. If, for example, crickets are bought from the store, they should be transferred to a „Faunabox“ and fed well for a few days with oatmeal, vegetables (e.g. carrots, peppers) or fruit before feeding. To prevent accumulation of pesticides, products from one's own poison-free garden or organic farms are definitely to be preferred here. In addition, the feeders should be dusted with a vitamin-mineral supplement or calcium. In the terrarium, isopods (e.g. *Armadillidium*) can also be kept, which not only provide a certain basic cleaning of the terrarium, but also serve as a permanent food reservoir.

The further care is uncomplicated. The water bowl should be removed from the terrarium at regular intervals depending on how dirty it is, usually about every 1-2 weeks, and cleaned thoroughly.

If gravel is used as substrate, it can be rinsed regularly. Other substrates should be changed every few weeks to months depending on the degree of contamination, newspaper about weekly. Cleaning of the glass walls of the terrarium is done as needed and is only for the keeper's aesthetic preference anyway.



Mallorcan midwife toads are very easy to care for and feed on readily available food insects ranging in size from „cricket small“ for toadlets to „cricket medium“ for adults

| Foto: Sergé Bogaerts



4.7 Breeding

If kept as described above, Mallorcan midwife toads will reproduce „all by themselves“. This means that no special mating triggers have to be provided. However, a certain seasonal variation in temperature and lighting duration supports the synchronization of reproduction and is recommended. In nature, the reproductive season lasts from about February to October, with mating beginning around May. During periods of greater heat in the summer, the animals stop reproducing.

Mating calls are soft, short, and high-pitched. They sound like a metallic „pi - pi - pi“; there are 1-3 seconds between each call. They sound a bit like a blacksmith hitting an anvil with a hammer, which is why the Mallorcan midwife toad has the Spanish name „Ferreret“ - „little blacksmith“. Both sexes call, the calls can be during the day and at night, and can be heard continuously during the breeding season, but they do not usually disturb even the most noise-sensitive people.

If a mating pair is found, the egg-laying behavior described in 3.1 „Biology“ occurs, in which the male wraps the egg strings with usually about 8-15 eggs around his legs. Egg-carrying males should be disturbed as little as possible and should not be taken out of the terrarium, because there is the danger that the eggs will be stripped off. It often happens that there are also unfertilized eggs in the clutch; this does not matter. On average, about 8-10 tadpoles hatch from a clutch. If clutches are largely or completely unfertilized, they are stripped by the male after some time. The male is much more shy than usual during the egg-carrying period and reacts with panic calls when approached. When the eggs are developed enough, the male goes to the water bowl or the water part of the terrarium, where he releases the hatching tadpoles into the water. The remains of the egg strings are eaten by the tadpoles. After hatching the tadpoles are about 2 cm long. The tadpoles are then caught and transferred to the rearing aquarium; however, it is also unproblematic for the small tadpoles to live in the water bowl for a few days.



Gravid female with eggs shining through abdominal wall
| Foto: Sergé Bogaerts



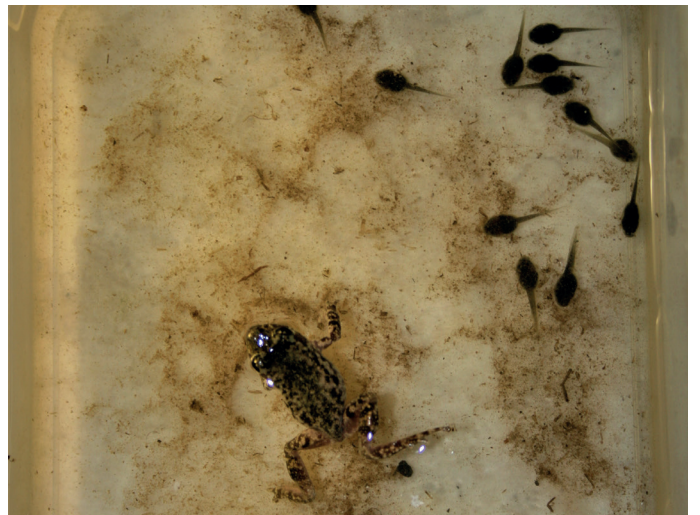
Carrying male with already more developed dark eggs
| Foto: Sergé Bogaerts



Egg-carrying male with fresh, still white eggs next to a female
| Foto: Uwe Seidel



Shortly before the hatching of the tadpoles, the male goes into the water and frees himself from the egg strings
| Foto: Sergé Bogaerts



Male in water with young tadpoles | Foto: Uwe Seidel



4.8 Rearing of offspring

Larvae rearing is also very uncomplicated compared to many other amphibians. The tadpoles are placed in an appropriately sized water container, such as an aquarium or plastic box. They can be kept together without problems, they are not cannibalistic and do not seem to bother or suppress each other. Different age cohorts can also be kept together. At least about one liter of water should be available for one larva, 2-2.5 L is even better. Thus, up to a maximum of 60 tadpoles could be raised together in a 60-liter aquarium.

It is not necessary to set up an aesthetically pleasing water tank. On the other hand, there is nothing against creating an attractive display aquarium for the tadpoles. However, many aquatic plants will be eaten by the tadpoles in the long run. A day-night rhythm should be available, separate lighting is not necessary.

Feeding is done with commercial fish food for herbivorous fish, spirulina flakes, pellets or e.g. previously scalded nettles, dandelion leaves or similar. The food is given daily and can be provided ad libitum.

The tadpoles of *A. muletensis* do not have any special demands regarding the water quality. Normal tap water can be used. If the water is chlorinated, let it stand in buckets for two days before use. If in doubt, always let it stand for two days before use.

Filters or aeration are not necessary in the rearing aquarium. The water should be partially changed about once a week. Depending on the number of tadpoles, 50-80 % of the water is sucked off and replaced by stagnant tap water of similar temperature. A possibly existing organic layer should not be removed completely, as it contributes to the stabilization of the aquatic environment. When changing the water, the water temperature of the new water should be approximately the same as the old water. The water temperature can be in the same range as the temperature for keeping adults, i.e. between 12 and 25 °C.

Moderate temperatures of 15-20 °C are more favorable for a healthy development and ensure that the young toads are already quite large when they move onto land. The development period depends on the water temperature - the cooler, the slower. At 15-20 °C it takes about 6-12 months until metamorphosis. The larvae can be maintained well for several months in winter at approx. 10-15 °C. This prolongs the development time and leads to larger tadpoles and young toads. At cooler temperatures the larval period can last 12-18 months.



The tadpoles are very large in size | Foto: Sergé Bogaerts



If the captive population is healthy and under the conditions described, the survival rate of larvae can be expected to be around 90%.

The tadpoles of the Mallorcan midwife toad are among the largest larvae of European anurans. They reach a length of just under 8 cm, but then become smaller again towards metamorphosis.



Tadpole with well developed hind legs
| Foto: Sergé Bogaerts



All four legs are developed, metamorphosis is imminent
| Foto: Philipp Ginal



Three developmental stages: still without legs, with all four legs, with tail already half reduced shortly before going on land (animals must be housed in a terrestrial enclosure at this stage at the latest) | Foto: Sergé Bogaerts



On land! | Foto: Sergé Bogaerts



As with all anurans, the hind legs develop first. If the forelegs break through later, it does not take long (one to two weeks) until the move onto land begins. When the tail of the four-legged larvae, which now already look very toad-like, has regressed about halfway, the animals can be transferred to a metamorphosis container. The timing should not be missed, otherwise the larvae can drown or easily escape, because they can also climb up glass or plastic walls when the time comes.

The metamorphosis enclosure should have a few centimeters (3-5 cm) of water and a „stepless“ accessible land part. Here you can use e.g. thick aquarium filter mats, which you put into the tank and which then serve as land part. Stones or plants (e.g. water plants) in the water provide further exit possibilities. Another option is to place the metamorphs in a slanted plastic box with gravel as the bottom substrate. If you then fill in enough water so that there is a water level of about 3-5 cm on the „deep side“, a „natural“ shore area is created, with a dry upper part and a submerged lower part, so that the small toads can easily reach land. Hiding places should also be provided here.

The metamorphs first cautiously „test move“ on land and frequently and quickly jump back into the water when disturbed. Only when the tail is completely absorbed, they remain permanently on land.



Freshly metamorphosed toad
in size comparison
Foto: Philipp Ginal



Then they are moved into their rearing terrarium, for which the same information applies as described above for the adult animals. However, small plastic boxes can also serve as a rearing terrarium. The rearing enclosure must also have a tightly closing lid (with ventilation), since the small toads can climb up glass and plastic walls. It is important to have a moist substrate, dry spots and plenty of hiding places. Soon after the disappearance of the stump of the tail, the small toads begin to feed. They eat comparatively large food animals from the beginning, so they can be fed with small crickets without any problems. Fruit flies and other common foods are readily eaten.

If the terrarium is large enough, the rearing of young midwife toads can be done in the terrarium of the parents; the animals usually get along without problems, but it is difficult to ensure sufficiently high feeder densities for the young.

Males become sexually mature at about 12 months, females at 24 months. The first clutches usually have little or no fertilization, so „proper“ offspring breeding usually does not start until the toads are three years old. The fertilization rate generally increases with age; on average, about 85% of the eggs laid are fertilized and about three-quarters of the eggs hatch.

Alternatively, breeding in an „outdoor aquarium“ (= bucket) in the garden/on the terrace is also possible. Direct UV light can have a positive effect; however, the containers should be well shaded. When reared outdoors in our latitudes, the larvae grow very large and usually overwinter.



Rearing enclosure



4.9 Husbandry problems

The Mallorcan midwife toad is a very uncomplicated, robust species, which can also be kept well by novice amphibian keepers. Its uncomplicated nature, also regarding the rearing of tadpoles, makes it an ideal species, e.g. also for school vivaria.

More common husbandry problems besides classical accidents (crushing in case of inadequately secured stone slabs, entrapment between furnishings, escape and subsequent fatal dehydration, etc.) are:

- Failures in tadpole development due to infrequent water changes
- Disturbance of the egg-carrying males, causing it to shed the eggs
- On the other hand, spawn-bearing males need to be monitored regularly, as it happens that the egg strings tightens too tightly and obstructs the blood supply to the limbs. This can lead to swelling of the foot and in extreme cases to its death, which in some cases can also mean death of the animal due to infection. The egg string can also cut into the skin. Therefore, if open wounds or a swelling foot are observed, the entire egg string must be removed manually; any minor wounds will usually heal quickly without further treatment.

A particular problem with *Alytes muletensis* is the chytrid fungus *Bd*. It is also unfortunately widespread in terrarium populations of this species. An explicit goal of CC is to eradicate it there. It has proven to be a problem that the fungus is often undetectable in toads. Even with repeated negative PCR testing of skin swabs, it is possible that the toads are *Bd* positive. The animals often live permanently with the fungus without any problems. On the other hand, outbreaks of the disease can always occur for unexplained reasons, such as changes in living conditions.

Animals in metamorphosis are particularly susceptible. Here, a *Bd* infection often show up. The toads then do not complete metamorphosis or die shortly afterwards.



One of CC's goals is to eradicate the chytrid fungus *Bd* from *Alytes muletensis* stocks; therefore, all animals are tested with swab samples prior to any relocation | Foto: Philipp Ginal



In response to this issue, the populations of *Alytes muletensis* in CC are monitored and tested more thoroughly than usual. We try to pass on only *Bd*-negative animals. However, due to the above-mentioned problems, a certain degree of caution is appropriate. In the case of unexplained deaths, the CC office must be informed immediately. The fungus is readily detectable in diseased or dead toads.

Bd-positive *Alytes muletensis* can be treated. Treatment protocols are available for both tadpoles and metamorphosed animals. The CC office will assist with treatment in the event of an emergency.

For safety reasons, the usual hygiene protocols recommended for any amphibian husbandry (see also the brochure that all CC participants receive at the beginning) should be strictly followed when keeping *Alytes muletensis*, e.g. separate accessories for each terrarium, hand disinfection after working on one terrarium (and before working on the next), disinfection of furnishings or substrate when replacing them. This is especially true if other amphibians are being cared for in addition to the Mallorcan midwife toads, so that the *Bd* fungus is not transferred from one enclosure to another (this goes both ways, of course). It is also very important to take precautions so that contaminated material such as sewage and furnishings do not enter the wild and endanger amphibians living there. For the disinfection of wastewater, e.g. heating or the addition of peracetic acid is suitable.





5. Further Literature

- BOGAERTS, S. (2012): *Alytes muletensis* – Keeping and breeding the Majorcan midwife toad. – DN magazine, Dendrobatidae Nederland Nr. 5 (2012-1): 25–29.
- BOGAERTS, S. & U. SEIDEL (2014): Pflege und Zucht der Mallorca-Geburtshelferkröte, *Alytes muletensis*. – Terraria/elaphe 1/2014: 64–71.
- BULEY, K.R. & C. GONZALES-VILLAVICENCIO (2008): The Durrell Wildlife Conservation Trust and the Mallorcan midwife toad, *Alytes muletensis* – into the 21st century. – Herpetological Bulletin 72: 17–20.
- BUSH, S.L. (1996): The reproductive behaviour of the Ferreret *Alytes muletensis*. – Boletín de la Asociación Herpetológica Española 7: 35–37.
- BUSH, S.L. (1997): Vocal Behavior of Males and Females in the Majorcan Midwife Toad. – Journal of Herpetology 31(2): 251–257.
- GINAL, P. (2020): Lebende Fossilien – Haltung und Nachzucht der bedrohten Mallorca-Geburtshelferkröte (*Alytes muletensis*). – Reptilia Nr. 145, 25(5): 54–62.
- HILGER, A. (2013): Die Mallorca-Geburtshelferkröte (*Alytes muletensis*). Ein Fossil aus der Eiszeit. – Terraria/elaphe 2/2013: 96–99.
- LEA, J., M. DYSON & H. HALLIDAY (2002): Phonotaxis to advertisement calls by midwife toads (*Alytes muletensis*) is not necessarily related to mating. – Amphibia-Reptilia 23: 151–159.
- MOORE, R.D., R.A. GRIFFITHS & A. ROMAN (2004): Distribution of the Mallorcan midwife toad (*Alytes muletensis*) in relation to landscape topography and introduced predators. – Biological Conservation 116: 327–332.
- SCHECKELER, H.-J. (2001): Geburtshelferkröten (Gattung *Alytes*, Discoglossidae): Biologie, Haltung und Nachzucht. – Draco Nr. 6, 2(2): 45–52.
- SCHLEY, L. & R.A. GRIFFITHS (1997): Midwife Toads (*Alytes muletensis*) avoid chemical cues from snakes (*Natrix maura*). – Journal of Herpetology 32: 572–574.
- TONGE, S. & Q. BLOXAM (1989): Breeding the Mallorcan midwife toad, *Alytes muletensis* in captivity. – International Zoo Yearbook 28: 45–53.
- WALKER, S.F., J. BOSCH, T.Y. JAMES, A.P. LITVINTSEVA, J.A.O. VALLS, S. PINA, G. GARCÍA, G.A. ROSA, A.A. CUNNINGHAM, S. HOLE, R. GRIFFITHS & M.C. FISHER (2008): Invasive pathogens threaten species recovery programs. – Current Biology 18: R853–R854.
- WELLS, E., D. GARCIA-ALONSO, G.M. ROSA, G. GARCÍA & B. TAPLEY (2015): EAZA Amphibian Taxon Advisory Group Best Practice Guidelines for Midwife toads (*Alytes* sp.). – First Edition. European Association of Zoos and Aquariums, Amsterdam, The Netherlands.