

Raising Metamorphosed Juveniles

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When just metamorphosed, young salamanders undergo some quite dramatic changes:

Breathing. Breathing doesn't happen through the gills anymore, but through the skin and lungs. Their skin starts to change and dries out into a rougher, sometimes granulated, land-phase skin.

Weight. They no longer get help from the water pressure to carry the weight of their body. Their tiny legs are not used to such pressure, so moving takes up much effort.

Food. Most of the food they are accustomed to eat in the water will probably no longer be available on land, and they'll need to discover what to catch.

No wonder that for the first few days, freshly metamorphosed juveniles lie still and passively undergo these dramatic changes. It's only after a few days that they will start settling in to their new environment and begin to forage about.

Outside Enclosures

From a friend, I learned a nice trick for raising land-phase juveniles outside in the garden. It's not something extraordinary and difficult, but really quite simple. How is it done?

Use a large and deep (at least 60 cm) plastic box or dustbin, and turn it upside down. Cut a hole in the bottom of the box, but be sure to leave overhanging sides of about 5 cm or more. Then dig a hole in your garden somewhere in a shaded place (for instance, underneath a tree or shrub) and put the box in it, top down. After filling up the sides of the hole around the box again, you will have just created an escape-proof hole. For the first 10 cm of soil inside the box, I use leaf compost that I get from a wood or park. This normally contains little bugs and slugs. The rest of the box is filled with rotten wood, moss, and wood again up to 10 cm from the top. After this is



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An outdoor enclosure.



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Indoor Terrarium

all installed, you can release your young salamanders into it and let them grow up. I've tried this trick with *Salamandra*, *Ambystoma*, *Triturus*, and *Cynops* species, and it worked real well in all cases.

Remarks

1. Take care that the ground is hard around the box, so that burrowing salamanders don't dig themselves out. Otherwise, you will need to set the box first on some iron fence or grating. It's important that the bottom be in contact with the soil, so earthworms can get in.
2. Go at least as deep as 60 cm if you want to keep your animals year round and frost free. This will also prevent moles from coming into the box to feast on what you've tried to raise so carefully. So if you can, avoid this drama.
3. It's important that direct sunlight doesn't shine right down into the box, since this would make temperatures rise pretty high, especially during summer weather. The shade will also help maintain enough humidity for both salamanders and prey.

Indoor Raising

Before you install your tank, you might consider posing to yourself the following question: What do young salamanders really need to develop well? Here so far are the answers that I have come up with: food, a hiding place, dry and wet places, and a good temperature. The latter, however, is something that will depend on the kind of species you are taking care of; young *Echinotriton/Tylotriton* and *Cynops ensicauda* for instance will not adore colder temperatures (less than 12°C), whereas species from other genera, such as *Notophthalmus*, *Salamandrella*, and *Onychodactylus*, will tolerate much lower temperatures, but will suffer from higher temperatures. For adult species, the preferred temperature might even differ depending on the elevation where they came from. So I'll leave finding the exact temperature to your experience with just this note: a "safe" temperature lies somewhere between 12 and 20 °C. If you're not sure about temperature, it's mostly better to err on the low side than on the high side.

Cynops / Paramesotriton / Triturus / Salamandra / Tylotriton

I have experimented with little raising “urodariums” that I install in the following way.

Soil and Food

As soil I use forest litter, which can be gotten from a forest or park. This compost-like soil contains many little insects, slugs, sow bugs, and worms. It even carries eggs of some little insects that will hatch and provide your youngsters with a rich variety of live food. Of course, I supplement this food and add mosquito larvae, little worms, and other little things that I can lay my hands on. Another important thing about this way of raising is that the young have to hunt for their prey and more or less carry out their ‘normal’ lifecycle. When do I refresh this soil? Well, after a while the soil will start to compost and will emit a thin smell of chloride. Then it’s time to change it and replace with new soil. I also tend to add some composted peat that I buy in a garden shop. It consists of cut-up sphagnum, which is often used for flowering plants and fern cultures since it is light and holds humidity well. It also has another very interesting capacity: it’s so acid that it will prevent development of some harmful bacterial infections in your young salamanders.

Tip. Write on your raising tanks how many little salamanders are inside, because when you refresh the soil, you really want to be sure you have taken all the animals out!

**WET and DRY places
AKA the skin problem**

My raising tanks are entirely closed off with a plastic plate; some have holes for air, others don’t. In them I place a little plastic bowl with a sponge in it. In Belgium, they sell a kind of sponge with one rough side for cleaning cooking pans. It has a hard scrubbing surface, which I use as follows: the sponge is put in the plastic bowl, which gets filled with water up to 1 or 2 mm above the sponge level. With so little water there’s no real possibility that your animals will drown, and they will be able to take up moisture when needed. Also, and certainly important for young, quick-growing salamanders, they need a place to change their skin, so they can use the rough surface

to wriggle it off. The air humidity will get high from the evaporation of the water in the bowl. If during repeated observations, you find your youngsters congregated on the water or in the cool wet place just beneath the bowl, then you might consider keeping the tank a little more humid.

Hiding Places

In nature, young salamanders often metamorphose in large numbers. They are particularly vulnerable at that time and preyed upon by many predators, including rodents, large bugs, adult salamanders, and birds. At the time of metamorphosis, young fire salamanders, for instance, do not yet have the ability to produce the milky poisonous skin secretion and are thus quite vulnerable. Finding a shelter in which to hide and undergo metamorphosis is thus a priority. In captivity, the predators won’t be there, as we know, but the little salamanders of course don’t, so why not help them feel comfortable and put in some flat pieces of wood or stones for them. Put in some little things to create a dungeon-like shelter. By day, they will congregate under their shelter and only come out during the twilight hours to hunt for prey. I use wood, since it serves several goals at the same time: it’s food for some of the little bugs and worms; it’s rough, so it helps the young salamanders molt; and it soaks up humidity well.

Hynobius

Young *Hynobius* need to have an extremely wet environment. I use the following “paludarium” setup (a terrarium with both water and land area) to raise several pond-type *Hynobius*; in all of the cases where I used this approach, I never lost a single *Hynobius* juvenile.

Soil

The soil of the rearing tank consists of gravel and/or sand. On top of this, I add about one cm of water. When not on the land area, the animals are thus immersed, and, at the same time, there’s little chance they will drown.

Land Area

Pieces of broken pottery and large flat stones can make up the foundations of the land area.¹ The idea is to create numerous

open places in between these stones as hiding places. From my lawn, I pick up moss polsters (sphagnum-like), which I use to blend in with and entirely cover the stones. In fact, it now looks as if you have created an emerald green island. Through the capillarity function of the stones, the water will reach even the highest stones, which will help the moss suck up the necessary water. On top of the moss and stones, you can eventually lay pieces of wood and plants. The whole terrarium is closed off entirely by a glass plate, making the air humidity very high. At night, when the temperature drops, you will see condensation on the glass. At the same time, by making the tank escape proof, the glass plate will also prevent your losing animals. *Hynobius* are the most likely to escape. If you want to make it all look natural, add a plant on top of the "mountain." A little plant that goes real well in such a setup is *Ficus repens*. Just take the plant out of the pot, wash the dirt off its roots, and put the roots in the water while laying the leaves on the land.²

Depending on the size of your setup, you'll

finally end up with a rich variety of hiding places with a large variation in humidity and temperature.

Remarks

1. For my land area, I use large special insulating bricks made out of lava. They have the advantage that they are perforated with 1.5 cm holes for insulating purposes. These holes always prove to hold numerous young, especially around water level.

2. When introducing plants from flower shops, be aware that most of the soil contains fertilizer. When the fertilizer comes into contact with the water, it can pollute it to such a high degree that it will affect the development of eggs and (eventually) larvae. I always wash the soil off entirely, thus avoiding this trouble.

Food

Most of the time, *Hynobius* don't really move around a lot, but in the fall and spring, when



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Hynobius tokyoensis juvenile

temperatures are between 12° and 16°, they are active and thus consume energy, so they'll need additional food. For this reason, freshly metamorphosed *Hynobius* young (metamorphosis starts around fall) develop a good appetite and should be provided plenty of food. If this need is not respected, they will start to supplement their diet with their younger brothers or sisters!! Since *Hynobius* are rare species in the hobby, we might try avoiding this state of affairs. *Hynobius* juveniles are not too difficult when it comes to food: anything that fits in their mouth and that's not too hard will get inside. I've fed them on buffalo worms, fly maggots, bloodworms, and, of course, the main dish—earthworms. Curiously enough, introduced slugs wandered around the tank for days. When raising young *tokyoensis* in 1997, I offered two medium-sized earthworms to each animal every two days. The animals doubled their size in just over a month! In this way, my one-year-old young were able to attain the length of three-year-old wild-captured animals (study by Kusano). So, don't neglect food. If you have put plants and wood on top of the island part, introduced buffalo worms will stay around, as will earthworms, even though they could escape.

Neurergus

The Eurasian salamander genus *Neurergus* includes very colorful species, which, through the efforts of some German herpetologists, have found their way into salamander husbandry. Not that many people keep these precious yellow diamonds, and I'm quite pleased to be keeping both *strauchii* and *crocatius*. In large contrast to their beauty stands the fragility of the animals, however. Evolutionarily, they diverged from the genus *Triturus* some 40 million years ago and adapted themselves to flowing-water conditions. I have been lucky enough to breed *strauchii* for three consecutive years; this last year I even obtained a fall and spring reproduction from my only couple. Because of the rarity of the genus and the scarce reports on its reproduction, I will describe both the approaches I used for raising juvenile *strauchii*.

Wet Approach

Following the guidelines of the original keeper of my animals (which are already F-4), I kept my *strauchii* in the following setup: the soil consists of gravel, above which is a little layer



Neurergus crocatus



Neurergus strauchii male

of water (from 2 to 5 cm deep). An island of stones takes up a third of the tank. Some of the stones are placed so that they lean down into the water with another one hanging over the top (like an umbrella). Some moss (*Fontinalis* sp.) will at the same time purify the water and prevent the crawling animals from drowning. Young *strauchii* tend to drown even in shallow water. *Ficus repens* on top of the stones both creates extra shelter—necessary to offer the juveniles peace of mind—and gives your setup an appealing look. The tank is sealed off entirely; the environment is very wet. Since *Neurergus* are found in lime-rich environments, I introduce some sand consisting of crushed shell into the water. Any pet shop should have this sand, which is most often used in canary cages. The crushed shells make the water hard. In this setup, my limited captive-bred *strauchii* of '97 and '98 grew up quite well.

After reading some reports and discussing the matter with other keepers at the annual Urodela meeting in Gersfeld, Germany, re-

cently, I was told that both adults and juveniles in fact did better in dry air, and that I might wish consider not closing off the tank. Since I had frequently found the juveniles congregated in the driest parts of the tank with only rare visits to the water to feed, I decided to try it out.

Dry Approach

Fill a 60 by 40 cm tank with a mixture of washed gravel and shell sand, adding only about 5 mm of water, just enough to cover the gravel and keep the humidity high in the lower part of the tank. Fill the whole tank with the insulating bricks in between which carpets of moss can be "woven." In a way this setup is the same as for *Hynobius*, but less humid. Again place a *Ficus repens* on top of this emerald green island. The tank is not entirely sealed off. Instead, the covering lid has an opening in the middle for fresh (dry) air. This difference causes the tanks to have a very dry upper level (with the heating of the

TL lamps) and a moisture-saturated level in the bottom. Two animals from the 1999 breeding (out of 24 juveniles) were first introduced to this "dry approach."

Comparison

During August '99 I compared the animals in the "dry" tank (group A) with those in the "wet" tank (group B). Both the A animals were larger than any animals in group B. They even surpassed in length the offspring from the 1998 breeding that were one year older. During my repeated observations, they have always been found in the dry top layers with nicely filled bellies. In both setups they always seem to hide in the holes of the bricks.

Food

Food offered consisted of buffalo worms, (little) fly maggots, bloodworms (offered both on land and in the water), little earthworms, millipedes, and slugs. All of these "happily" disappeared. These species are not as aggressive when feeding as other newts. Whereas *Cynops* and *Triturus*, for instance, snap at each other (to preserve discovered prey for themselves), this rarely occurs with either of my *Neurergus* species.

Personal Note

The general idea of this article is to give some suggestions for raising young terrestrial salamanders. It is restricted to my own captive-breeding experiences, with the addition of some literature studies and personal communications with other urodele keepers. With time and experience, new techniques might be added/discovered. Despite all efforts spent raising young *Paramesotriton*, for instance, it still seems to be a troublesome experience: especially the terrestrial phase is very critical, and most commonly offspring are decimated during this period. Although one Belgian specialist in the field has succeeded with third generation reproduction of *hongkongensi*, the raising of juvenile *caudopunctatus* and *chinensis* is still not optimized or even known. More observations and experiments on soil pH, temperature, and food could reveal worthwhile ways for enhancing the success ratio. But such data are very scarce, at least at this moment. There's still much interesting work to do. Constructive comments on these topics are always welcomed.