

OBSERVATIONS ON THE FIRE SALAMANDER IN PORTUGAL, WITH NOTES ON OTHER TAILED AMPHIBIAN SPECIES AND THEIR CARE IN CAPTIVITY

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INTRODUCTION

The following is a report of observations made during three separate trips to Portugal over the past five years. Each trip, of one week, was made during the last week in December. Two of the trips were made to the Estoril region just West of Lisbon and the third was centred on the Monchique area of the Algarve.

ESTORIL REGION

Salamandra salamandra gallaica

During the first trip larvae were found at only one location at the site of a monastery in Peninha. The area immediately around the monastery was deciduous woodland and larvae were found in a small cistern of approximately one square metre. The water was between 30 and 40 cm deep, clear and weed free. Apart from the small area of deciduous woodland, the majority of the area was of *Eucalyptus* plantations. No adults or juveniles were found in the vicinity.

The second visit proved more successful with adults, larvae and a single juvenile being collected. The adults and the juvenile were collected from ornamental gardens at Sintra. They were all collected in the daytime during a period of heavy rain and rain had been falling for several days prior to the visit. Three adult specimens were collected beneath a pile of rotten logs, one juvenile from under a stone and the fifth specimen was found between long grass and a stone wall. All appeared to be using temporary refuges during the period of rain, a visit to the same location later in the week after only a few days of dry weather revealed no further specimens. The trees were mainly deciduous with ivy (*Hedera sp.*) and *Helixine* covering a layer of dead leaves and leaf mould at the base of the trees. The soil underneath appeared to be well drained having quite a high sand/grit fraction. Large boulders and groups of rocks could be found throughout the gardens and these are possibly permanent refuges for salamanders during the summer and other dry periods of the year.

Larvae were found in a number of artificial ponds within the gardens and the size of the ponds varied between one and four square metres. Some contained water plants, whilst others were completely bare and the depth of water varied between 20 - 40 cm. Larvae were also found in temporary rivulets of water running alongside paths and roads within the gardens. It is likely that many of these larvae would perish during the onset of dry weather.

The four adults and one juvenile specimen were brought back to England under licence with the intention of setting up a captive breeding group. Unfortunately the sex ratio was only one female to four males and this female has only produced larvae on two occasions. The five specimens, now adult, are maintained in a 90 x 30 x 30 cm glass aquarium with

a six cm gravel base covered with a 10 cm layer of leaf mould. The aquarium is kept in a centrally heated room with an east facing window, the temperature rarely drops below 10°C. Feeding is relatively simple with the main food being field crickets (*Gryllus sp.*) dusted with Nutrobal multivitamin supplement. Earthworms and slugs of various species are also provided at irregular intervals. A bowl of water 15 cm in diameter and 3 cm deep is placed in one corner of the aquarium. Adults are sexually active throughout the year with most activity in the Spring and Autumn. Males vigorously pursue females manoeuvring underneath them and attempting to link their front legs with hers. Deposition of the spermatophore has not been observed.

The female deposited 15 dead larvae, six undeveloped ova and a single live larva on the 23rd June 1992, and two live larvae on the 25th of May 1992. All were deposited in the water bowl. Only the single larva deposited in June metamorphosed. It was reared in a plastic box 20 x 15 x 8 cm with 2 cm of water, some water plants (*Cabomba sp.*) and a piece of earthenware pot to enable metamorphosis. The larva was kept outside and fed on a mixture of bloodworms, chopped earthworms and *Daphnia* and metamorphosed after 54 days. At metamorphosis the baby salamander was 3.7 cm in total length of which the tail comprised 1.6 cm.

At the time of writing all specimens are alive and feeding well and it is hoped that breeding will be more successful in future years. An attempt at cooling and then simulating heavy rainfall may be successful in eliciting females to produce young. This method has been used successfully by other breeders.

Triturus boscai

Individuals of this species were found on both visits to the Estoril region. During the first visit only a solitary adult was found under a piece of bark in the ornamental gardens at Sintra. During the second visit breeding adults and terrestrial juveniles were found throughout the park at Sintra. A total of five juveniles were found beneath piles of dead leaves that had blown alongside a stone wall. None of the juveniles appeared to be greater than 4 cm and it is likely that they had metamorphosed earlier the same year. Adults were found in a number of artificial ponds throughout the park and the size of the ponds varied from approximately one to ten square metres. A total of four specimens were seen in the smaller pond although it is very likely that further specimens were present. No eggs of this species were obvious although a thorough search was not made. All specimens observed and collected were returned to the wild, no specimens were brought back to England.

Triturus marmoratus marmoratus

This species was found in two locations in the Estoril region and all with one exception were observed in breeding condition in a variety of artificial ponds. A solitary male was found at the base of a stone wall within the main park at Sintra. Other specimens at Sintra were observed in both the large and small artificial ponds in which the *T. boscai* were breeding. The male found at the base of the wall was much greener than the aquatic specimens, some of which were darker and almost brown in colouration. No more than half a dozen specimens were seen in total.

The species appeared to be more prolific at Mafra where again it was found in a number of small artificial ponds of approximately one square metre. The ponds were within a public garden in the centre of Mafra and contained water approximately 60 cm deep. Larger ponds were present but because of the cloudiness of the water no specimens were observed. Although small, one of the ponds contained at least ten adults and smaller numbers could be seen in other ponds. The pond containing most adults also contained large quantities of blanket weed (filamentous algae) in which were found large numbers of

newt eggs. A total of six adults were collected and brought back to England under licence.

A small group of adults (one male and two females) have been successfully maintained and have bred each year since their collection. They are housed in an outdoor glass vivarium 120 x 35 x 35 cm and normally enter the water (in the vivarium) for breeding in the Autumn. They are removed from the vivarium in December and before the temperature drops low enough to freeze the water. During the winter, spring and early summer they are maintained in a glass aquarium 90 x 30 x 30 cm in a shed where the temperature is maintained above 4°C. Aquatic adults are fed on crickets, worms and slugs. Eggs are laid on *Cabomba sp.* or *Elodea sp.* and removed weekly to a separate tank for the subsequent rearing of the larvae. Newly metamorphosed young are fed on newly hatched crickets (*Gryllus sp.*) dusted with Nutrobal. Young have matured after only two years and are now in breeding condition.

MONCHIQUE REGION, ALGARVE

Salamandra salamandra crespoides

A single, successful trip was made to this region during December of 1991, the main collecting area being centred on Monchique and its surrounding villages. The area was visited specifically to collect specimens of the recently described subspecies *S. s. crespoides* Malkmus, part of the *S. s. gallaica* complex. Details of its distribution and distinguishing characteristics are to be found in the paper by Malkmus (1983). However the main differences from the subspecies *S. s. gallaica* are the extremely long digits, smaller flattened head and the presence of large numbers of very small light coloured spots on the body of the adult. It is distributed throughout the Serra de Monchique in the Algarve. It is a large subspecies with adults commonly exceeding a total length of 25 cm.

During the week of the visit the weather remained dry with daytime temperatures reaching the low 20's Centigrade. This meant that adults and juveniles were unlikely to be found easily outside of their normal refuges. Larvae were however found at three different locations within the Serra de Monchique and their presence in all cases was associated with the cegonhas or albercas used by many of the growers in the region. Cegonhas are deep cylindrical wells, often surrounded by a retaining wall whilst the alberca is a rectangular and often quite shallow cistern. The importance of these and other manmade structures to amphibians and their larvae has been discussed by Malkmus (1982).

Larvae was found at Foia in a small temporary stream no more than 30 cm wide and 8 cm deep, the water was fairly fast flowing but contained grass and other emergent vegetation that had fallen into the water. The stream linked two albercas at different points on the hillside which was terraced with each level being separated by dry stone walls. The vegetation on the hillside consisted mainly of deciduous trees interspersed with grass and bramble covered areas, rock outcrops could also be found. The larvae were small, not exceeding three centimetres and appeared to have been recently deposited.

More larvae were observed and collected at Peso, a small village to the North of Monchique, the size of the larvae found here was greater than at Foia and many larvae observed exceeded five centimetres, the maximum recorded size was 5.4 cm. The larvae were found in a concrete alberca of approximately sixteen square metres. The water was clear, deep (45 cm), absent of any vegetation and fed by an outfall pipe from a second alberca further up the hillside. The vegetation in the area was similar to that at Foia but the terraces were better maintained and used for hay making. A fully metamorphosed specimen was also observed and collected, this specimen was approximately seven centimetres long. It had either only recently metamorphosed or had fallen into the alberca

the previous evening. Further specimens were collected by a colleague from the same locality during March 1993 which at metamorphosis had a mean snout vent length of 2.93 cm and a mean tail length of 2.62 cm (n = 6).

Observations of larvae were also made on the road from Monchique to Alferce. Where the road ran through dense cork oak (*Quercus ruber*) woodland both types of wells could be found. Brambles, ferns and mosses were found covering the ground. A large adult, over 25 centimetres long, was found swimming in one of the ceghonas, and small larvae (4-5 cm) were found in the alberca. The adult had obviously fallen into the well but was successfully netted. The alberca was approximately the same depth as those at Peso but had a rich weed growth of Starwort, *Callitriche sp* and duckweed *Lemna sp.*; recently deposited larvae, 3 cm long, were netted and brought back under licence.

A total of 20 specimens from the three locations are now maintained and observations on their behaviour, colouration and growth are being made. Although specimens were only separated by a distance of less than eleven kilometres the colouration and growth rate of specimens has varied greatly. The differences are possibly due to the fact that natural barriers in the form of a series of hills confine certain populations to isolated valleys. However the *S. s. gallaica* complex in Portugal has a diversity of colour morphs and patterns throughout its range. Some of these have now been given sub specific status ie. *crespoi* and the electrophoretic and morphometric work of Joger and Steinfartz (1994) has identified a further two subspecies from Southern Spain, *S. s. morenica* and *S. s. longirostris*. It is likely that further investigations will identify other subspecies in the future.

Specimens originally collected as larvae have now matured and sexual activity has been observed in the specimens collected from Foia. Of the five specimens three are males and one of these has been observed attempting to mate with one of the females. A total of sixteen larvae were produced by a single female early in December 1993. All appeared to be healthy but premature with only the first pair of legs being developed, some specimens still having retained remnants of the yolk sac. The mean total length of eight specimens was 2.37 cm of which 1.09 cm was the tail. A further 19 larvae were deposited in early January 1994 but these were further developed than specimens in the previous batch and all possessed hind limbs or hind limb buds. A third batch of 45 larvae was deposited later in January 1994, these appeared to be well developed although four pairs of larvae were joined at the yolk. Development of all batches has progressed normally with the first specimens metamorphosing at the end of April 1994. The first juveniles to metamorphose did so during a period of exceptionally warm weather when temperatures in the greenhouse, in which they were maintained, reached 25-30°C. The mean snout/vent length of the first metamorphosing juveniles was 2.73 cm, the mean tail length 2.41 cm (n=18). All larvae were reared in groups of eight to twenty and fed on bloodworms and *Daphnia* in aquaria with biological or undergravel filters. Adult specimens from both Foia and Alferce are maintained in similar vivaria to those from Sintra, however a large water container (25 L x 20 W x 15 D cm) has replaced the original water bowl. Water in the container is circulated using a small biological filter, and regular water changes are also made. The addition of a water container with a circulation system may be an important factor in stimulating the females to deposit juveniles.

From the few observations I have made and from discussion with other colleagues it is likely that in the wild most larvae are deposited in the Autumn and Winter months and during times of high rainfall. It is likely that larvae would metamorphose throughout the Winter and Spring, with development being accelerated during warm weather. Certainly the larvae collected during December of 1991 metamorphosed within 12 - 39 days of

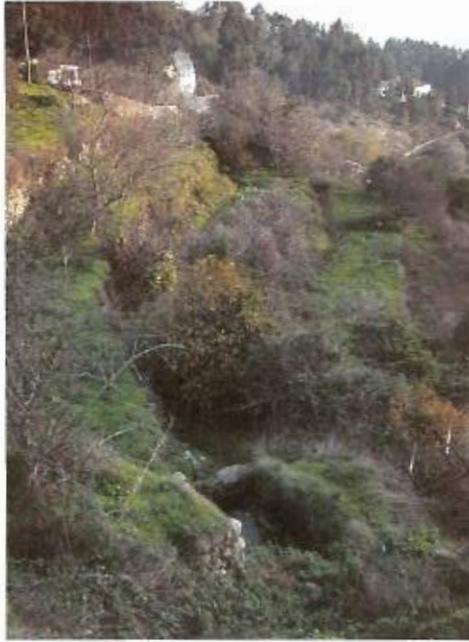


Plate 1. Habitat of *Salamandra salamandra crespoi*, Foia



Plate 2. *Salamandra salamandra crespoi*, adult male, Foia



Plate 3. *Salamandra salamandra crespöi*, portrait of adult male, Foia



Plate 4. Early metamorphosed juvenile of *Salamandra salamandra crespöi*, note the absence of adult colouration

collection, mean 25 days ($n = 11$), and before they reached the maximum size attained by some larvae observed at Peso. Metamorphosed specimens were olive brown in colouration and only attained the yellow and black adult colouration after a few weeks. This contrasts with other subspecies, e.g. of *S. s. salamandra* and *S. s. terrestris*, which have developed the adult colouration prior to metamorphosis. The deposition of premature larvae may be an adaptation to the extreme environmental conditions or simply be a factor of captivity.

Specimens collected from Alferce reached a mean snout/vent length of 5.37 cm and a mean tail length of 4.6 cm ($n = 7$) after only eight months, those from Foia had reached 5.86 cm snout vent length and 4.5 cm tail length during the same period ($n = 5$). Six of the specimens from Alferce had attained a mean snout vent length of 7.38 cm and a mean tail length of 7.58 cm 20 months after metamorphosis. Although no sexual activity has been observed in the latter group it is likely that some specimens are sexually mature. All juvenile specimens were reared indoors at room temperature and at no time has any attempt been made to hibernate them. Judging from the reproductive capacity of specimens from Foia this appears to be unnecessary.

Triturus boscai

Adults of this species were found at three separate locations in the Algarve. The largest number of adults were found in an alberca at Foia and of seven specimens captured only one was female. All were in breeding condition. The alberca contained large quantities of filamentous algae and Starwort, *Callitriche* sp.; no eggs of this species were found. Adults were also found in the same albercas during March of 1993. A newly metamorphosed juvenile was found close to small stream in which the previously mentioned larvae of *S. s. crespoi* were found. Adults were found in the same albercas as the *S. s. crespoi* larvae found at Peso, probably no more than six adults could be seen in the clear and weedless water. Both males and females were present. A solitary adult was observed in another alberca on the road between Caldas de Monchique and Marmalette.

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