



Neurergus (Cope, 1862) Spotted Newts / Middle Eastern Newts



Neurergus crocatus, photo © Department of Zoology, Adnan Menderes University, <http://zooloji.adu.edu.tr>

INTRODUCTION

The genus *Neurergus* is comprised of four species, *N. strauchii*, *N. crocatus*, *N. microspilotus*, and *N. kaiseri*. All four species are found in the Middle East, in the countries of Iran, Iraq, and Turkey, and occupy ranges of small proportion compared to many other Salamandrid species.

The genus *Neurergus* is closely related to the Old World genus *Triturus*, with which many similar characteristics are shared (Schmidtler, 1994). *N. kaiseri* is particularly especially similar to the Alpine Newt, *Triturus alpestris*, in terms of morphology and habit.

N. strauchii, *N. crocatus*, and *N. microspilotus* are similar in general appearance, with dark colored bodies contrasting bright yellow spots, and in fact, the genus was once considered a monotypic one. *N. kaiseri* is perhaps the "outcast" of the group, with its black and white mottling, and orange dorsal stripe. *N. kaiseri* also reproduce in still ponds, while the other three species are stream dwellers. *N. kaiseri*'s unique reproduction environment is thought to be a representative example of genetic adaptation, as opposed to environmental plasticity (Steinfartz et al., 2002). The larvae of *N. kaiseri* are definitively pond type, with squat bodies, long gills, tall tail fins, and a shorter larval period. There are also remarkable osteological differences between *N. kaiseri* and *N. strauchii* (Haller-Probst & Schleich, 1994). Such genetic adaptations might warrant separation at the genus level, or higher, in many cases, however, the stream-dwelling characteristic that dominates in *Neurergus* is thought to be ancestral, with the intrageneric conversion to pond environments in the case of *N. kaiseri* occurring at some point in the evolutionary process (Steinfartz et al., 2002), and subsequently leading to genetic adaptations. This scenario is more likely than a case of recurrent parallel evolution from a pond type reproduction to a stream type in the case of *Neurergus*.

Neurergus crocatus (Cope, 1862)

N. crocatus are similar to *N. strauchii* in size and coloration; i.e. dark colored dorsa and contrasting yellow spots, and lengths of up to 18 cm. However, the spots of *N. crocatus* are larger than those of *N. strauchii*, and the belly is solid or nearly solid red-orange, as opposed to the thin orange ventral line of *N. strauchii* (Sparreboom et al., 2000). *N. crocatus* males do not develop a bluish sheen along the tail, as is observed in *N. strauchii*.



N. crocatus, photos © Henk Wallays, Henk.Wallays@pandora.be



N. crocatus, photos © Henk Wallays, Henk.Wallays@pandora.be

Neurergus microspilotus (Nesterov, 1917)

N. microspilotus is also dark colored with bright yellow spots. This species is rather small compared to *N. strauchii* and *N. crocatus*, reaching lengths of 14-15 cm total. The ventral coloration is similar to *N. crocatus*, consisting of solid or nearly solid orangish-red. Like *N. crocatus*, *N. microspilotus* males do not develop a bluish sheen along the tail during breeding season (Sparreboom et al., 2000).



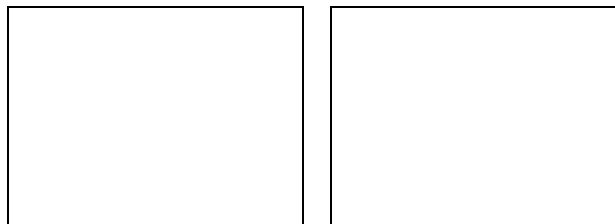
N. microspilotus © Henk Wallays, Henk.Wallays@pandora.be

Neurergus strauchii strauchii (Steindachner, 1887)

Neurergus strauchii barani (Öz, 1994)

N. strauchii spp. are medium sized newts, reaching up to 18 cm in total length. The dorsum is black or dark brown with contrasting yellow spots. The spots are found from the head, to the tip of the tail, including the limbs, head, and flanks. *N. s. barani* possess spots of smaller circumference than those of *N. s. strauchii*. The belly of both subspecies consists of an irregular orange line extending from the chest to the tail tip, and surrounded in dark coloration that lacks yellow spotting. When aquatic, the skin may take on a rather velvety texture, while terrestrials usually have moderately rough skin. Males of both subspecies develop laterally compressed tails, and a bluish-white sheen along the lateral side. This dimorphic trait is not observed in any other *Neurergus* species, and in fact is the only sexually dimorphic color change observed in the genus (Sparreboom et al., 2000). Over-wintered larvae develop adult coloration before metamorphosis, and so juveniles typically possess adult coloration upon metamorphosis. This species also produces a "golden" variant, pictured below, whose yellow spots look as though they've been smeared together.

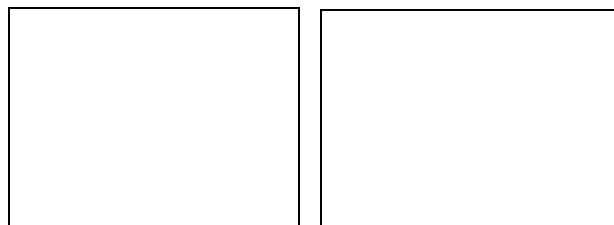
and pattern of this species. *N. kaiseri* is the smallest species, reaching only 10 cm in total length (Sparreboom et al., 2000).



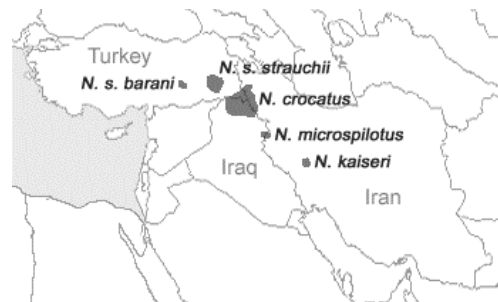
N. kaiseri, photos © Christoph Bork, Christoph.Bork@t-online.de

DISTRIBUTION & HABITAT

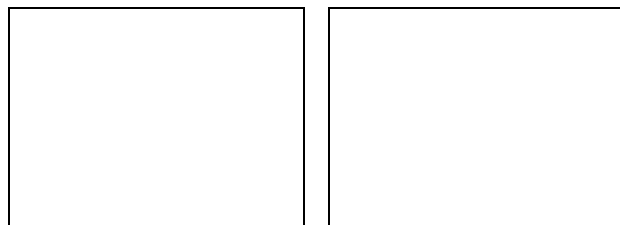
All four species are found in the Middle East, in the countries of Turkey, Iraq, and Iran. *N. crocatus* are found at the convergence point of the three countries, within a range that includes southeast Turkey, northwestern Iran, and northeastern Iraq (Steinfartz, 2002). Both subspecies of *N. strauchii* are found west of the Van Lake in Turkey, in two disconnected zones of the eastern and central areas (Sparreboom, 2000). *N. microspilotus* is found along the mid-border of Iran and Iraq, extending slightly into both countries. *N. kaiseri* are found in western Iran, in the province of Luristan (Sparreboom, 2000).



N. s. barani (left) © Henk Wallays, Henk.Wallays@pandora.be
N. s. strauchii (right) © Jessica Miller, jess@livingunderworld.org

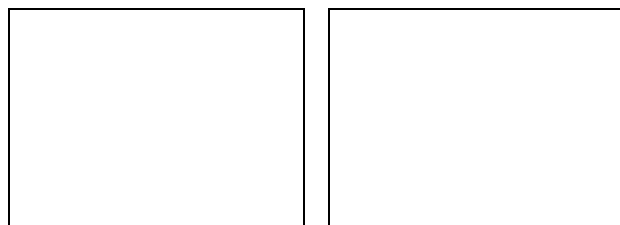


The ranges occupied by all species are rather small in comparison to some other species, and all are disconnected. The map below, adapted from Steinfartz, 2002, shows an estimation of distribution of all four species.



N. s. strauchii normal juvenile (left), and golden variant (right), photos © Paolo Mazzei, Amphibians & Reptiles of Europe

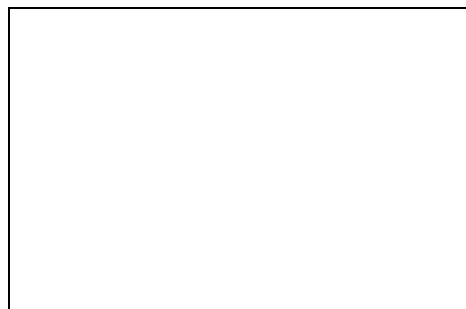
N. strauchii, *N. crocatus*, and *N. microspilotus* are stream breeders, while *N. kaiseri* utilize still ponds for reproduction. Outside of the breeding season, *Neurergus* typically remain terrestrial. The terrestrial habitat is considered rather arid, and includes de-forested grasslands, and semi-deserts near mountain streams at elevations of 500-1750 m.



N. s. strauchii larvae, photos © Henk Wallays, Henk.Wallays@pandora.be

Neurergus kaiseri (Schmidt, 1952)

As mentioned earlier, *N. kaiseri* is markedly different in appearance and morphology than the other species. *N. kaiseri* possess large, irregular black and white markings of various size and shape about the dorsum. The percentage of black or white coloration varies among individuals, with some being mostly white, mostly black, or anywhere in between. *N. kaiseri* also possess orange colored dorsal stripes, bellies, undersides of limbs, and orange coloration about the upper limbs and feet, adding to the striking color



Mountain Stream, Zagros Mountains, Iran, photo © Dr. Attila I. Gulyás, Institute of Experimental Medicine, Hungarian Academy of Sciences, <http://www.koki.hu/~gulyas>.

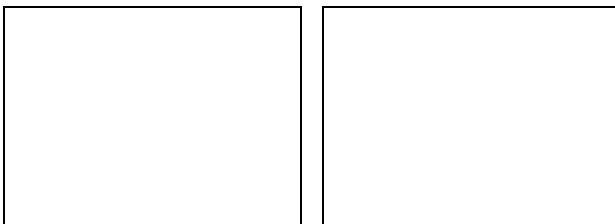
COURTSHIP & BREEDING

This section consists of a summary of results obtained by Sparreboom et al., 2000, and should be viewed as a general guide to breeding behavior.

The courtship behavior of *Neurergus* is similar for all four species, and resembles that of some *Triturus* species, namely *T. alpestris*.

N. crocatus, *N. strauchii*, and *N. microspilotus* will actively pursue females and attempt to block their path, while pursuit is limited in *N. kaiseri*. *N. microspilotus* males survey their surroundings from an elevated spot, and return there after unsuccessful pursuits. Tail fanning is observed in all four species, which consists of the male folding the tail along the side of the body and undulating the the entire tail, or only the distal portion, usually while standing perpendicular to the female. Males may fan from either the left or right side. The amplitude of the fan is smallest in *N. kaiseri*. There is a noticeable difference in the duration of fanning bouts between *N. strauchii* and *N. crocatus*, with those of *N. crocatus* being longer in duration than *N. strauchii*. After a period, the male will attempt to lead the female off by creeping in front of her, while undulating a slightly raised tail. A responsive female will follow, occasionally undulating her tail. Shortly thereafter, the male deposits a spermatophore and leads the female over it, at which point he pivots 90° to a perpendicular position. This is commonly known as the "brake", and effectively stops the females progression such that her cloaca is just over the spermatophore. Competing males of *N. strauchii* may interrupt a courtship display in progress, thus assuming the courting position.

Females of *N. strauchii* and *N. crocatus* deposit eggs on the undersides of flat rocks, while *N. microspilotus* opt for crevices or hollows of stones. *N. kaiseri* females deposit eggs on shaded, rough surfaces, including, but not restricted to the undersides of stones.



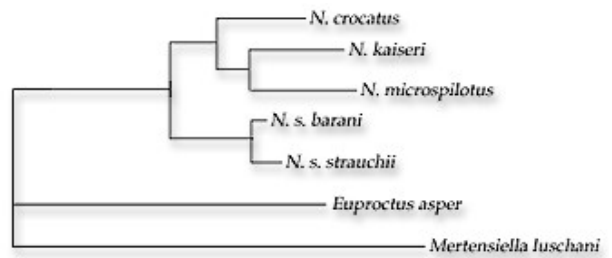
N. s. strauchii eggs (left), *N. crocatus* larvae (right), photos © Henk Wallays, Henk.Wallays@pandora.be

The stream dwelling species may spend up to two years in the larval form, over-wintering in the aquatic environment, and metamorphosing at a considerable size. Over-wintering larvae develop the characteristic yellow spots on a black background before metamorphosis, and morph at a rather large size compared to *N. kaiseri*. *N. kaiseri* larvae do not over-winter, and metamorphose at a smaller size than the stream breeders. Stream larvae possess characteristics adapted to flowing water, including a longer, thinner physique, shorter gills and tail fins to reduce drag, and short limbs and digits. Larvae of the pond species possess longer gills and tail fins, longer digits and limbs, and a short, squat body.

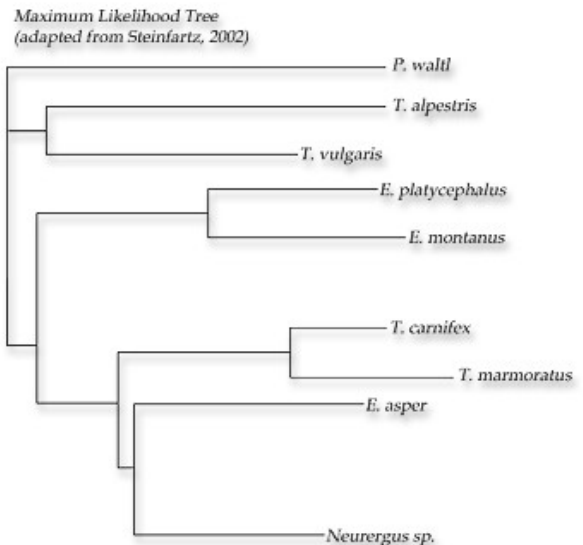
CLADISTICS & PROPOSED MONOPHYLY

Molecular studies using *N. strauchii* as a representative of the entire genus place *Neurergus* close to *Triturus* and *Euproctus asper* (Steinfartz, 2002). As mentioned previously, there are notable osteological differences between *N. strauchii* and *N. kaiseri*, while *N. kaiseri* shares similar morphology and habit with *Triturus alpestris* (Haller-Probst & Schleich, 1994).

Molecular studies have supported monophyly of *Neurergus*. Steinfartz et al., 2002, showed the existence of two further clades within *Neurergus*; the *crocatus-clade*, consisting of *N. crocatus*, *N. microspilotus*, and *N. kaiseri*, and the *strauchii-clade*, comprised of only one species and two subspecies, *N. s. strauchii* and *N. s. barani*. The two clades separated somewhere in the range of 8.5-13.9 mya, while speciation occurred within the *crocatus-clade* at an estimated 5 mya, and finally subspecies differentiation within *N. strauchii* occurred around 2.5-3 mya (Steinfartz et al., 2002).



(clade adapted from Steinfartz, 2002)



Maximum Likelihood Tree (adapted from Steinfartz, 2002)

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