

***ELAPHE RADIATA* (SCHLEGEL, 1837) BY FOUL MEANS OR FAIR**

By: C.M. Langeveld, Cantharel 12, 2925 DJ Krimpen a.d. IJssel, The Netherlands.

Epilogue by: Drs. M. Maas, veterinary surgeon, Animal clinic Waalwijk, Eerste Zeine 96, Waalwijk, The Netherlands.

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INTRODUCTION

The keeping and breeding of Asian snakes of the genus *Elaphe* is becoming more and more popular. Formerly these animals could only be acquired through commercial sources, nowadays however, offspring of most species from this genus can be obtained from individual breeders. The snake I will describe in this article is *Elaphe radiata*, the 'rayed' or copperhead snake. These beautiful animals were, and unfortunately are still, being, imported in large numbers. Most of these animals quickly die of parasites and infectious diseases, despite treatment with medicines (Schulz, 1986). This is even more reason for successful breeding of this snake.

DESCRIPTION AND BEHAVIOUR

Elaphe radiata is a slim snake, capable of reaching a length of approximately two meters. On average, however, these animals do not exceed 180 centimetres. Because of their wide distribution their colour is highly variable. Schulz (1986) describes yellow, orange, red, brown and olive-green coloured individuals. After shedding, the skin of the snake is strongly iridescent, much like the skin of *Elaphe helena* after shedding. The head of the animal is copper coloured. Around the eyes the snake shows a number of rays that run from each eye in several directions. Two of these rays run from the eye to the back of the neck where they, after a short interruption, continue as two stripes down the back. Both sides of the front part of the body display two black stripes that are connected in several places by black blotches. The back part of the animal, approximately one third of the body, is evenly coloured. The scales of *Elaphe radiata* are mostly smooth but on the back they can be strongly keeled.

Copperhead snakes are very aggressive and shy. The animals flee instantly when disturbed. My experience with these snakes is that when the animals are disturbed and do not have the opportunity to hide, they take on a typical defensive posture. The animal bends its upper body in a S and flattens its neck vertically. By flattening its body white blotches appear on the sides. Together with the black stripes and blotches one could take these for 'eyes.' If the animal still feels threatened it strikes out at its attacker with a wide opened mouth. Noticeable with a bite of this snake is that the animal holds on to its attacker and makes a chewing movement. Schulz (1986) mentions another defence mechanism i.e. when seriously disturbed the animals pretend to be dead. I have experienced this reaction once when administering liquid food to a snake

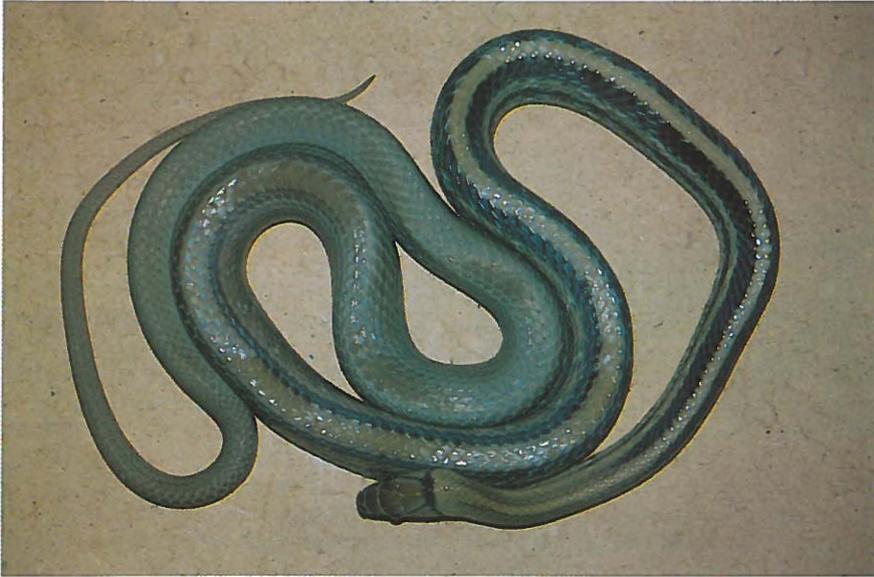


Foto 1: *Elaphe radiata*, man, bovenaanzicht, male, dorsal view.
Foto C.M. Langeveld.



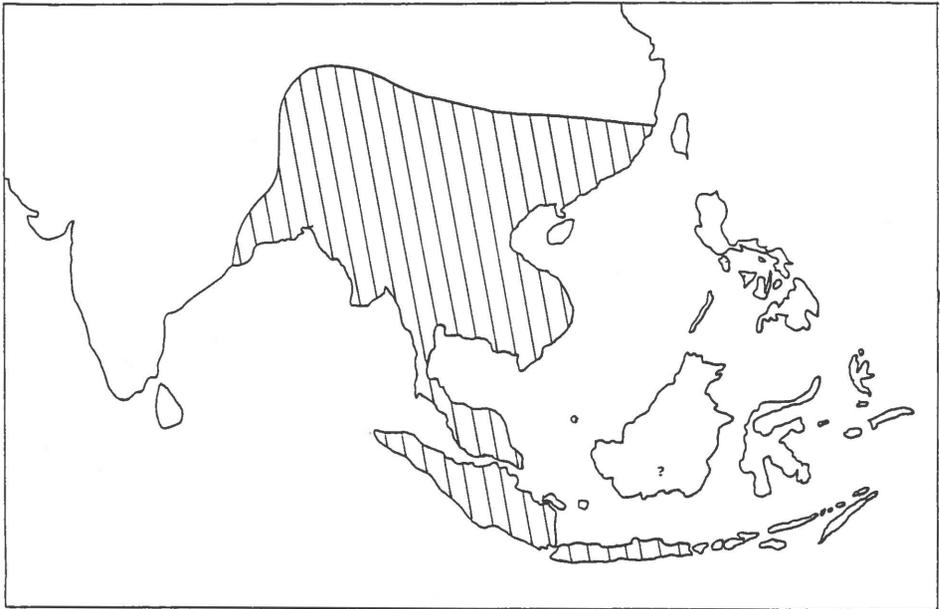
Foto 2: *Elaphe radiata*, man, zij aanzicht, male, lateral view.
Foto C.M. Langeveld.

through a tube (I will return to this later in the article). The animal pretended to be dead in my hands. However she 'revived' as soon as the tube was removed from the animal.

DISTRIBUTION AND HABITAT

The copperhead snake is distributed widely (see map). This area starts at the Mahandi river in India and runs from Assam, Sikkim, Bangladesh, Burma, the south of China, Cambodia, Vietnam, Laos, Thailand and Malaysia to the isles of Sumatra and Java (Schulz, 1986). Possibly *Elaphe radiata* also occurs on Borneo.

Elaphe radiata occurs both in the flat country as well as in the mountains. It is found in grassy river beds, meadows, open forests and cultivated areas (Mehrtens, 1987).



ATTENDANCE

In August 1990 I bought three *Elaphe radiata* in Germany. These consisted of an orange male (M1), a yellow female (F1) and a red-brown female (F2). These animals were of the first generation (F1) that had been bred in captivity. They were approximately 25 cm long and very aggressive. The animals were each kept separately in 'macrolon' boxes of 20x10x10 cm (lxwxh). The boxes were furnished with a piece of tissue paper, a quarter part of an egg box that served as a hiding place, and a small water container. Every other day a little amount of water was poured into the egg box to maintain a high humidity.

The macrolon boxes were placed on a heating cable that heated part of the boxes 24 hours a day. From the moment they arrived, the animals eagerly accepted newborn mice. This is surprising since, in the few months before I bought them, the animals had not eaten voluntarily.

The last owner, where the animals had been born, had to force feed them several times. Apparently, the 'stress' of the transport had a good effect on the animals.

The snakes grew well for the following months. Whenever the animals were lifted they started to rotate their tails strongly (like a propeller) at the same time emptying their intestines completely. I solved this problem by lifting the animals at both the neck and the tail and that way saved myself a pair of clean trousers. This reaction of fear c.q. defence stopped when the animals were approximately half a year old.

After the animals had reached a length of approximately 60 cm they were transferred to two terraria of 80x40x60 cm (lxwxh). At a height of 30 cm a wooden ledge was placed for the animals to lie on. The terraria were heated by a 25W spotlight and bottom heating. The latter covered about one-third of the floor area and was left on for 24 hours a day. The temperature inside the terraria varied between 28-30°C during the daytime and 22 -24°C at night. It should be noted that at night the animals had the opportunity to lie in a warmer place than just mentioned. Inside the terrarium two boxes were placed that served as hiding places, a piece of a root of a walnut tree and a water bowl. At the bottom there was a 3 cm thick layer of sawdust since, in my opinion, this is the most hygienic substrate.

The copperhead snake is an easy snake to take care of. Both females are kept separately from the male in one of the terraria previously mentioned. The snakes are active all through the day and like to burrow through the sawdust. When the light is turned off in the terrarium the animals can often be found lying on the ledge. Unlike most snakes in the genus *Elaphe* the animals are not curled up nicely but rather in loops in which the body is lying in waves. This phenomenon was also noted by Schulz (1986). *Elaphe helena*, *Elaphe climacophora* and *Elaphe taeniura* were also reported to show this behaviour (Schulz, 1986 and T. Steehouders, pers. comm.).

The animals are fed once a week and depending on their size, they get mice or half-grown rats that I offer them alive. At every feeding the animals receive two items, which they constrict. While the animals are eating it is important not to disturb them otherwise they will not eat the prey or regurgitate. During the period of shedding I spray the terrarium every day to promote a good slough.

BREEDING

As previously mentioned the animals grew well. In september 1991 the lengths of the animals were 130 cm for M1, 160 cm for F1 and 140 cm for F2. Considering their sizes, the animals appeared sexually mature and a breeding attempt was made.

On the 10th of October, 1991 I placed F1 and M1 together. On the 25th of October I separated her from the male without having noticed a copulation. On the 27th of October I placed the male and F2 together, the latter having shed her skin that day. On the 28th of October, at 18.00 hr, I recorded a mating between M1 and F2. I could not determine the length of the copulation since it took place inside a box. On the 11th of November the male was taken away from the female and F1 was placed together with F2. F1 shed her skin on the 23th of November and the 25th of December, 1991 and F2 shed her skin on the 5th of December, 1991 and the 9th of January, 1992.

From the 1st of December 1991 onwards I placed a plastic deep-freeze box of 20x20x10 cm (lxwxh), half-filled with moist sphagnum, inside the terrarium in which both females were kept. A hole of approximately 5 cm was cut in the lid of the box. F1 and F2 both ate mice up to two weeks before laying their eggs. Rats were no longer accepted alive during the last month before laying.

On the 9th of January 1992, after more than 70 days of gestation, Female 1 laid four eggs inside the box. Unfortunately, this happened during my holidays, and therefore I did not



Foto 3: *Elaphe radiata*, jong in broedstoof, young in incubator.
Foto C.M. Langeveld.



Fotot 4: Dood jong met dooier, dead young with yolk.
Foto C.M. Langeveld.



notice until the 12th of January that the animal was in laying distress (egg-bound) and needed treatment. A report on this can be found in the epilogue. The eggs were placed in an incubator by a relative of mine, where they were kept 'au bain marie' at a temperature between 27 and 29°C. Pre-boiled sphagnum was used as a substrate inside the incubator.

Because of her treatment, F1 had to be kept separate from the other animals and therefore I placed M1 and F2 together on the 13th of January 1992 and F1 in the terrarium of the male. At that time F2 was just laying her eggs inside the previously mentioned deep-freeze box. After F2 had laid her eggs, and left the box, nine eggs, which she had carried for 60 days, were taken out of the terrarium and put inside the incubator. When I looked in the terrarium two hours later I was startled to see F2 and M1 in copulation again.

Twenty days after laying the eggs, on the 3th of February 1992, inspection of the eggs in the incubator showed that three of the nine eggs of F2 had died and the four eggs of F1 were all in good condition. On the 17th of March 1992, after 68 days of incubation, all four eggs of F1 hatched. On the 18th of March, after 64 days of incubation, five out of six good eggs of F2 hatched. The sixth egg had been punctured but contained a big yolk and a full-grown young which had died. All young snakes were approximately 25 cm in length and shed their skins after 7 and 11 days. The young are the exact image of their parents. On the 30th of March 1992 six out of nine young ate thawed new-born mice, while on the 7th of April, 20 days after they were born, all young ate live new-born mice.

Notable is the relatively short incubation time of the eggs. K.D. Schulz mentioned a incubation period of 78 to 85 days (pers. comm.) and Schmidt (1990) mentions a incubation period of over 85 days for the eggs of *Elaphe radiata*. According to K.D. Schulz (pers. comm.), the incubation time of the eggs depends on the length of the time the eggs were carried by the snake (i.e. long carrying period - short incubation time or short carrying period -long incubation time). This is partially confirmed by the following incident.

On the 15th of February 1992, 29 days after the copulation, I unexpectedly discovered a partially dried cluster of eggs inside a box in the terrarium of F2. The cluster contained nine eggs and had to be a couple of days old. As previously mentioned, I was surprised since the first gestation of F2 had taken approximately 60 days and that of F1 more than 70 days. Moreover the animal had not shed her skin since she had laid her first clutch of eggs. The eggs could not be saved, but this incident prompted me to provide a place in the terrarium all through the year, in which the snake could deposit her eggs.

THE TREATMENT OF FEMALE 1

On Sunday the 12th of January, female 1 was operated on by M. Maas, a veterinary surgeon in Waalwijk who is experienced in the treatment of reptiles. During this operation seven eggs were removed from her body (see epilogue).

After the operation she was placed in the terrarium of the male, after this had been disinfected and furnished with old newspapers instead of sawdust. Two plastic deep-freeze boxes were provided as hiding-places. For the first seven days after the operation the snake was administered antibiotics orally once a day by means of a needle-less syringe. Despite the large wound, the snake kept well and she could be found lying in one of the two boxes. On the 28th of January the animal was inspected by veterinary surgeon Maas. In his opinion the wound was healing well since it was completely closed and the snake gave a good overall impression. The wound was to be embrocated lightly with eye ointment containing vitamin A in order to help the skin surrounding the wound during the sloughing that was at hand. At the time of inspection the cloudy period of the shedding cycle had just finished.

When the animal still had not shed its skin one week after the inspection, I decided to help. The snake (with the exception of the wound) was submerged in lukewarm water for 5 min. Following this I began to peel of the skin starting half way down the body. During the peeling I noticed that the old skin was very thick. It sometimes even seemed as if some colour of the new skin also came off. The skin surrounding the wound shed very easily. When I came to the head the old skin could not be removed from the eyes and therefore I decided to stop. The snake felt sticky after shedding and the stickiness did not disappear during the following days. Possibly a new shedding had started under the old skin and this incompletely rejected skin was also removed by me during the peeling.

Because the animal did not hide anymore in the boxes and I could see the heart beating through the skin, I decided to force-feed the considerably weakened animal. Using a tube, I fed the animal two yolks, supplemented with a teaspoon-full of Gistocal. Subsequently the animal was placed back in the terrarium. Initially it stayed curled up inside one of the boxes but two days later she laid fully stretched in the terrarium. One morning, a few days later I found the animal dead.

The seven eggs that had been removed surgically were immediately placed in an incubator. Initially the eggs looked good but after one day the eggshells turned brown. In March 1992 the eggs were opened and cut in four parts. They all turned out to be infertile.

CONCLUSION

During the writing of this article, on the 1st of April 1992, female 2 laid a third clutch of eleven eggs. In order to save her for the rest of the year I keep her strictly separated from the male. Producing three clutches of eggs in only a few months is more than enough for her! This article shows that captive bred *Elaphe radiata* are fairly easy to breed so possibly in the future importation of these animals will no longer be necessary.

If one keeps the following conditions in mind, *Elaphe radiata* will be a snake that can be kept and bred fairly easily by everyone;

- Keep young *Elaphe radiata* separately in small containers until they are approximately 60 cm.
- In view of their rapid metabolism, don't wait to long with force-feeding the young (Schulz, pers. comm.).
- Protect *Elaphe radiata* from large fluctuations in temperature (rise/fall).
- Don't disturb the animals while they are eating.
- Supply them with adequate hiding places.
- Supply a permanent place in the terrarium for the females to deposit their eggs.

Finally I would like to thank Drs. M. Maas for his expert help and treatment of my *Elaphe radiata* and for writing the epilogue.

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EPILOGUE (by Drs. M. Maas)

On Sunday the 12th of January 1992, the snake under discussion (F1) was taken to the animal clinic in Waalwijk for being unable to lay her eggs. Three days before, the snake had laid four eggs. It was clear however, that some eggs had remained behind. Most of them were grouped together, but one egg was separate, more in the direction of the cloaca. The eggs were very sharply bordered and the abdomen was extremely tense. By means of massage, the eggs could not be moved in the oviduct. Therefore, the laying distress was not caused by insufficient contraction of the oviduct and application of labour stimulating medication was not expected to be successful. Nevertheless, initially it was tried to relieve the laying distress by the administration of Calcium (Calci-tad®), 0.5 ml per kg of body weight). Since no change in the situation had occurred after a couple of hours, oxytocine (1 I.U. per kg body weight) was subsequently administered. Since the snake also did not react to this labour stimulus, and the eggs could not be removed by the natural route by means of massage, surgical removal (cesarian section) of the eggs was chosen.

The snake was narcotized by means of inhalation-anaesthesia using Halothane, laughing-gas and oxygen in a half-open system (Philippe Ayre T-piece). During the induction, a gas mixture was used composed of 1/3 oxygen, 2/3 laughing gas and 3.5% Halothane. This gas was administered through a mask. At the moment the snake was narcotized deeply enough, the gas was administered by a little hose in the trachea (intubation by means of a braunule, diameter 1.2 mm) and the Halothane percentage lowered to 1.5 - 2.5%, depending on the frequency of breath and heartbeat, which were checked regularly during the operation.

Since the eggs were spread widely, it was decided, after disinfection, to open the body cavity at the ventral side, just alongside the middle line. Although in my opinion a flank incision is to be preferred, in this case, this method was less suited since the overall picture is reduced and less room for manipulating the eggs is obtained. After opening the body cavity and seeing eggs in the oviduct, it was clear that removal of the eggs would be no sinecure. Between the eggs, the oviduct turned out to be heavily contracted so that moving the eggs through the oviduct by massage was very difficult.

While moving the eggs towards the operation wound, it also became clear that the oviduct was extremely fragile, particularly the left oviduct, in which the most posterior egg was situated. This regions was very brittle and contracted, so that the eggs could not be moved without the oviduct becoming torn. Since several eggs were present in this oviduct it was decide to perform a partial hysterectomy. The oviduct and the blood vessels were tied using reabsorbable suture (Vicryl® 4-0). The eggs in the right oviduct were removed through two small incisions. The oviduct was closed using soluble suture (Vicryl® 4-0 atraumatic) by means of a continuing stitch according to Lembert. Both the eggs and the oviduct showed no traces of inflammation or any other abnormalities. The body cavity was rinsed with a physiological salt solution. The peritoneum was closed by a continuing stitch using soluble suture (Vycril 4-0 atraumatic). The abdominal wall (muscles and skin) was closed by lying U-stitches using Vycril 3-0. The stitches were made under the scales by which the abdominal wall was closed strongly bulging out. To awaken the snake 100% oxygen was applied for 10 minutes. The snake woke up from the anaesthesia within a few minutes but it remained weak for a few hours. To prevent any inflammations in the body cavity, the snake was treated post-operative with antibiotics for seven days (Leotrox® 20 mg per kg of body weight).

Directly after the operation the eggs were placed in an incubator of approximately 28°C until they were picked up by the owner together with the snake. Although initially the snake recovered well and the abdominal wall healed nicely, the snake died 4 weeks later.

It is of course regrettable that the snake eventually died after an initial recovery. Unfortunately, no autopsy was performed and therefore one can only guess at the cause of death. One of the possibilities is a complication due to the operation, possibly an infection or inflammation.

Usually, however, these occur directly after the operation. Another post-operative complication is a coalescence or adherence in the body cavity, preventing certain organs in their function. This possibility can not be excluded. The snake experienced problems with shedding of its skin by which a possibly unripe skin was exposed. Therefore, it is not impossible that the snake lost much fluid by evaporation, or that an infectious microorganism entered the body through the skin thereby causing a fatal inflammation. Finally, prostration as a result of a prolonged period of non-eating, in combination with the energy-demanding recovery following the operation, can not be excluded as a reasonable cause of death.

With regard to the cause of laying distress, no obvious reason was apparent during the operation. From the bad state of the oviducts, it can be concluded that in the case of true laying distress one should not wait too long in taking action. When a snake is in laying distress, i.e. the belly is tightly bent around the eggs and the eggs can no longer be replaced, it is useless to wait any longer than one day. Quick action, whether or not operative, increases the chance of a successful outcome by which the reproductive organs can be maintained.