

COLUBRID BREEDING IN CAPTIVITY

by
**Gerold and
Gindy Merker**

A number of species make rewarding captive-breeding subjects.

Twenty years ago, the single bedroom in our apartment was furnished with snake cages, mostly 10-gallon aquaria with lock tops. We thought we were on the cutting edge of snake husbandry when we found out that a female hognose snake had laid seven eggs, even though they were dried out. Our ignorance meant we hadn't noticed that she was gravid.

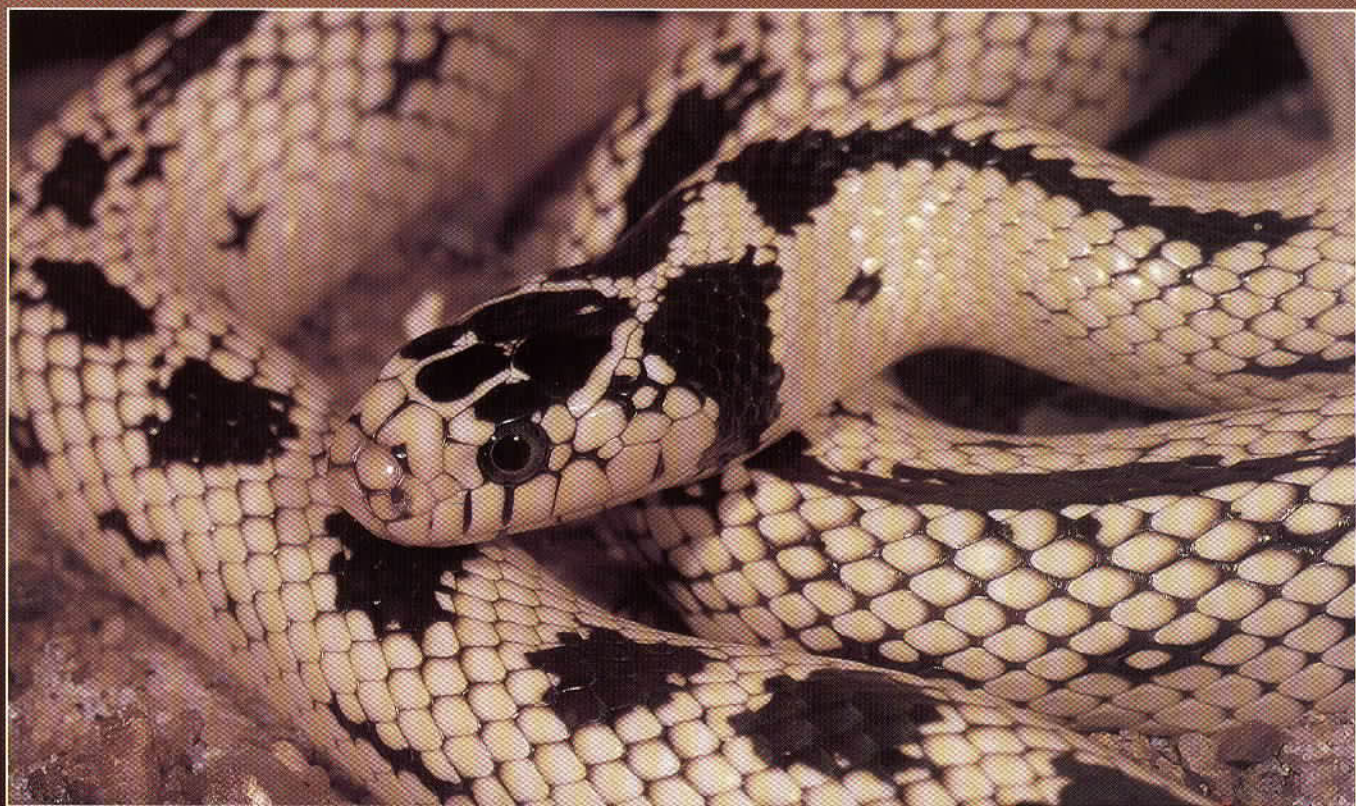
Excitement at the realization that these animals may actually reproduce in captivity for the average herpetoculturist (snake keeper back then) led us to begin experimenting with breeding the animals in our collection. Over the years, we have become increasingly successful in this venture. Today, between 80 to 90 percent of our

females lay fertile eggs for us each year. Today we also know when an animal is gravid and when it is about to lay eggs. Now we treat that animal with the care it needs and deserves. Besides hognose snakes, our colubrid breeding program has included several varieties of milk snakes, Sonora mountain kingsnakes, common kingsnakes, gray-banded kingsnakes, gopher snakes, corn snakes, gray rat snakes, green rat snakes and Trans Pecos rat snakes. The information we have gleaned from reading and listening to others, combined with our own trial and error, have brought us to the point where we now can feel confident about which techniques will ensure healthy breeding animals year after year.



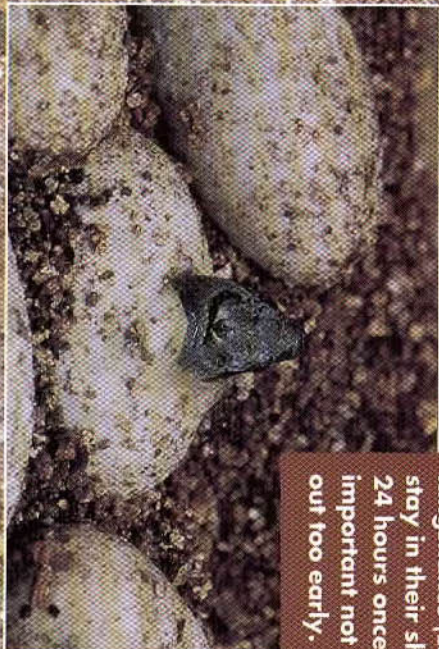
Gerold Meeker

The California kingsnake (*Lampropeltis getula californiae*) is a superb subject for captive breeding. They are easily maintained, are beautiful and come in a wide variety of morphs. The form shown here has reduced black pigment.



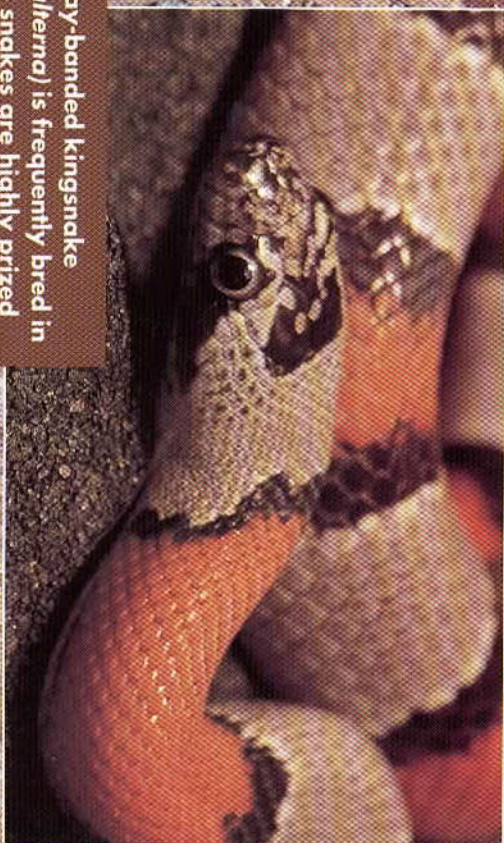
Bill Love

High yellow or "banana" California kingsnakes are popular with many herpetoculturists. Intense yellow with reduced black coloration is the goal of most breeders.



This clutch of hatching gray-banded kingsnakes (*Lampropeltis alterna*) will stay in their shells for approximately 24 hours once they have pipped. It is important not to pull colubrid neonates out too early.

The popular gray-banded kingsnake (*Lampropeltis alterna*) is frequently bred in captivity. These snakes are highly prized because of their variability and beauty.

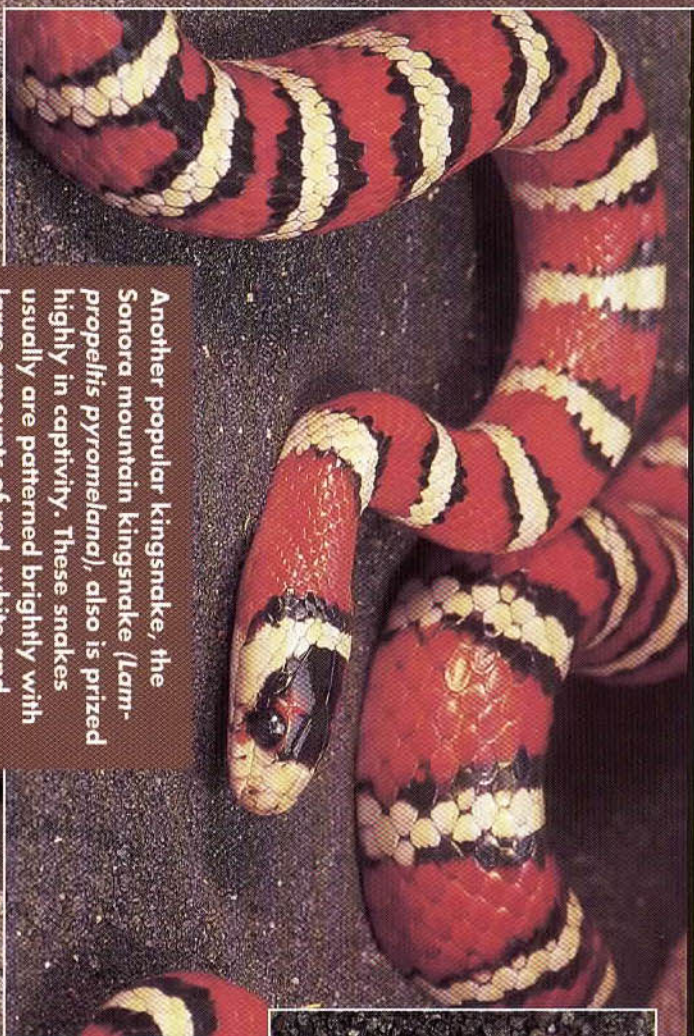


A number of rat snakes are commonly bred in captivity, and some of them are quite popular with hobbyists. This is a Trans Pecos rat snake.

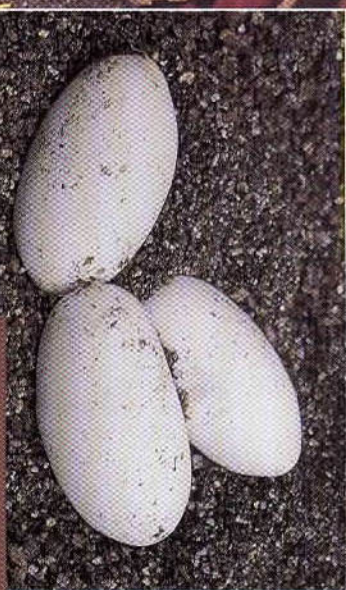
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Photo by Zig Leszczynski
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Another popular kingsnake, the Sonora mountain kingsnake (*Lampropeltis pyromelana*), also is prized highly in captivity. These snakes usually are patterned brightly with large amounts of red, white and orange. Many herpetoculturists feel this form is the most attractively patterned colubrid.

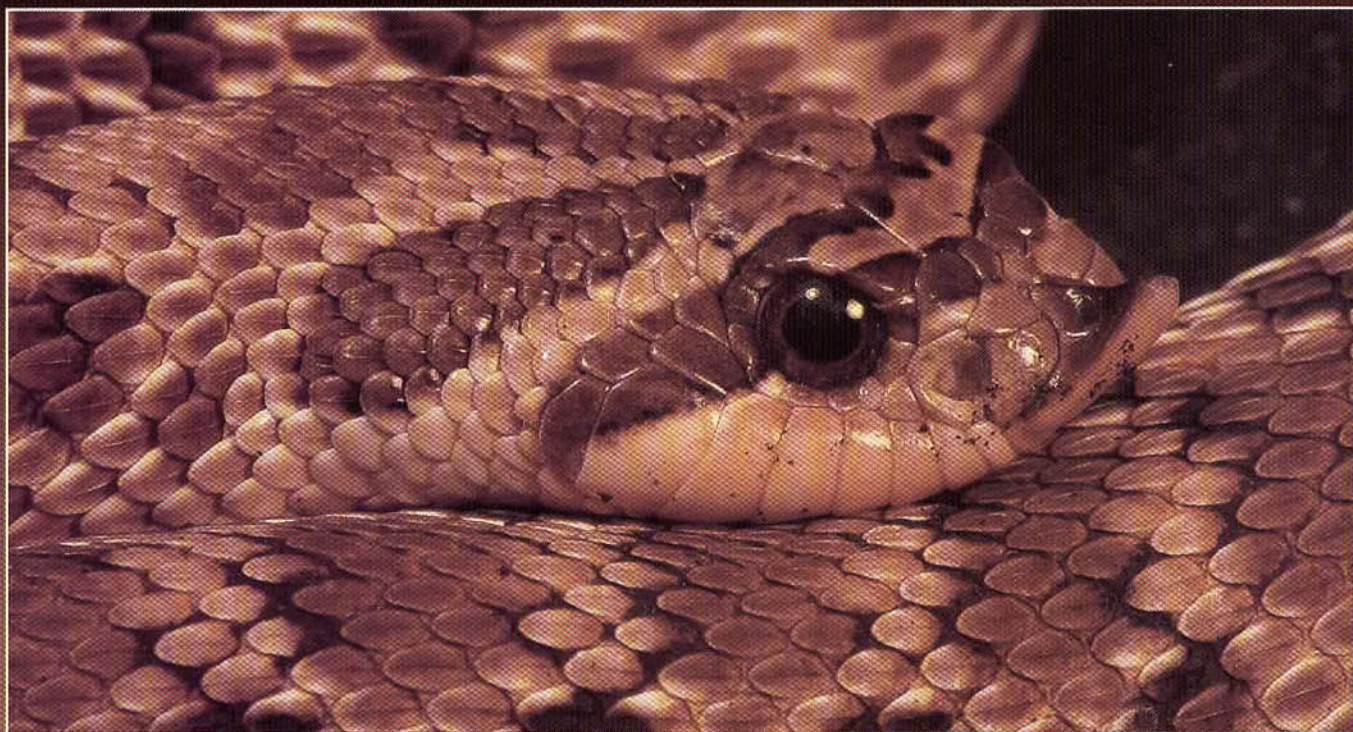


Photos: Gerold Marker



These eggs are from a Sonora mountain kingsnake. In the authors' collection, clutch size in this species varies from two to eight eggs. This particular clutch was from a young female, hence the smaller clutch size.





Gerald Marker

The western hognose snake (*Heterodon nasicus*) has become a popular colubrid species to breed. Their "cute" appearance, along with their propensity to feed on domestic mice, makes them popular with herpetoculturists. This form, the Mexican hognose snake (*H. n. kennerlyi*), was the first colubrid snake bred in captivity by the authors.



Gerald Marker

A very important parameter to successfully breeding animals in captivity is to ensure they have adequate energy stores for egg formation. A female gray-banded kingsnake is fed more frequent meals of smaller food items during the spring. If all goes well, this snake will produce fertile eggs within six weeks after breeding with the male.



Gerold and Cindy Merker

This photo shows a comparison of corn snake tails from a sexual pair. The male's tail is on the bottom. Notice the more "filled out" appearance of his tail. This is because his copulatory organs are housed in this region. The female's tail has a slimmer appearance because she obviously lacks these organs. The differences can be extremely subtle, so a much more accurate determination is made by using probes.



Gerold Merker

The western green rat snake (*Senticolis triaspis intermedia*) has rarely been bred in captivity. This particular breeding represents the second ever in captivity. The substrate was removed from the cage to allow the authors easier access to some of the cloacal fluid that could be collected on the substrate-free surface. This reduced the amount of time the female would have to be disturbed.

Physiological Cycling

Snakes, like other animals, receive cues from their environment to carry on important life processes such as reproduction. Potential cues include, but are not limited to, a change in day length, a change in temperature and food availability. Captive snakes need to be provided these environmental cues to continue their important life functions. We have found that one of the most important stimuli for inducing captive reproduction in colubrid snakes has been a winter cooling, or brumation, period.

During past years we have experimented with several strategies in order to provide our snakes with environmental changes. These strategies included: 1) changing the photoperiod without a corresponding drop in temperature; 2) changing the photoperiod with a corresponding drop in ambient temperature and 3) dropping the ambi-

ent temperature with no change in photoperiod. To change the photoperiod, we would decrease the amount of time the lights were on in the fall and then increase the length of time the lights were on as spring approached. This was an attempt to mimic the natural changes that occur in temperate regions. Methods two and three met with similar results—the snakes reproduced successfully. Method one resulted in very little snake reproduction. This implies, although by no means proves, that dropping the ambient temperature is a more important cue than varying the photoperiod when inducing colubrid snakes to reproduce in captivity. During years when the photoperiod was not altered, lights in the snake room were turned on and off with no regard to the natural length of daylight outside. However, there is the possibility that our snakes cued into a natural photoperiod,

because the snake room did have several windows.

When we first started maintaining snakes in captivity, we were cautious about the idea of cooling snakes during the winter. Initially, we never cooled snakes during the winter months; instead, we kept them warm throughout the year. We noticed that the feeding response of many of our captives became substantially reduced during fall, winter and early spring. Also, as mentioned earlier, our snakes reproduced only marginally. After reading several articles in the late 1970s (Kaufeld, 1969; Wagner, 1977 and others), we decided to allow our snakes access to cooler temperatures during the winter months. This was not without a certain amount of anxiety on our part, but we soon discovered a couple of interesting phenomena. First, our snakes' feeding response increased during the



Gerold Merker

In the authors' collection, Sonora mountain kingsnakes breed earlier than their gray-banded kingsnake.



Gerold Merker

This pair of gray-banded kingsnakes bred for 20 minutes. Within six weeks, the female laid a clutch of eight fertile eggs.



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These two Okeetee corn snakes are mating. The mating process typically lasts from three to 30 minutes.

early spring after the artificial "spring warm-up." Second, the snakes were induced to breed in captivity. If an animal from a temperate region is healthy, a winter cooling period is an important husbandry procedure for captive snake maintenance and reproduction.

Winter cooling is accomplished easily, especially if you live in an area where temperatures decrease markedly during the winter. For the past 15 years, we have used the following regimen for a winter cooling period. In mid-October, we stop feeding our snakes. During the next 10 to 14 days, the snakes are maintained with access to warm regions in their cages. This is done in order to allow the animals to digest their last meals. Once we feel comfortable that our snakes have excreted the remnants of their last meals, we turn off the heat to the cages. Some people choose to do this gradually; we simply turn the heat off all at once. The cages are then allowed to cool down to the ambient temperature of the room. During early November, our room temperature stays at approximately 60 degrees Fahrenheit (15 degrees Celsius); during December, January and early February, the room cools down to 50 to 55 degrees Fahrenheit (10 to 12 degrees Celsius). We maintain our snakes at these cool temperatures for a period of 90 to 100 days, allowing them access to water. Obviously, during this time period, we offer the snakes no food. Dur-

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ing this brumation period, we check our animals several times monthly to ensure that they are doing satisfactorily at the reduced temperatures.

A second important aspect to physiological cycling is the feeding regimen. We feed our snakes, especially females, heavily during the "spring warm-up," which occurs for most of our animals during the middle of February. This not only ensures that the snakes have adequate energy stores for the energetically taxing task of reproduction, it also provides the stimulus that prepares the animals for the breeding season. We have found that thin females may not reproduce, or if they do, the eggs are fewer in number and are less likely to go full term.

The feeding response during spring can be incredible. Snakes that were reluctant feeders during the prior fall often come out of brumation with an intense feeding response. In fact, a husbandry strategy we frequently use with reluctant feeders, including hatchlings, is to cool them down during winter to induce an increased feeding response during spring. Our adult females are fed several smaller-than-usual prey items with the arrival of spring. This ensures that they can quickly digest their meals and decreases the chance of regurgitation. We have also found that frozen, then thawed, food items are often better digested, once again reducing any chance of regurgitation. Love (1993) stated that frozen, then thawed, food items were easier for the snake to digest. Veer (1996) found that snakes often preferred the frozen, then thawed, food item; we have found this to be the case in our collection, as well. We are very careful with feeding during spring, because a regurgitation by a female at this time of year may result in her laying fewer eggs, or even no eggs at all. Although we have no quantitative evidence, we have observed poor egg-laying performance by female snakes that regurgitated at least one meal during spring, including gray-banded kingsnakes (*Lampropeltis alterna*), Baird's rat snakes (*Elaphe bairdi*) and Mexican milk snakes (*Lampropeltis triangulum annulata*).

Although still poorly understood, the addition of supplements to prey items offered to the breeder snakes may have an impact on the successful reproduction of at least some species. As mentioned elsewhere (Merker and Merker,

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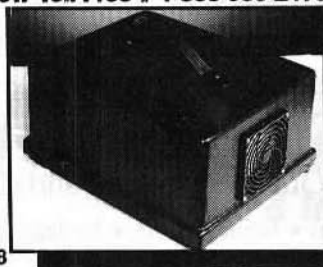
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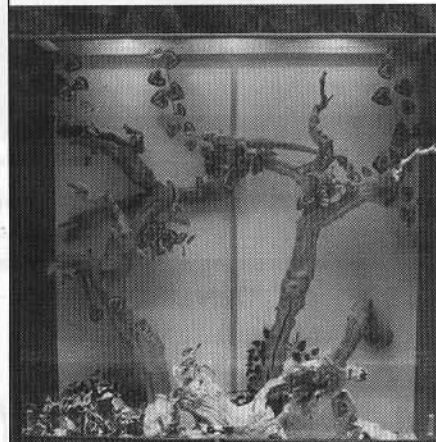


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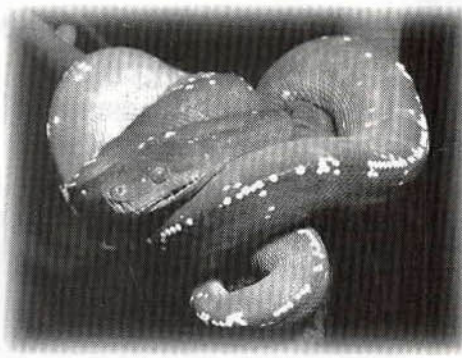
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1996a; Merker and Merker, 1996b), we have had tremendous difficulty in breeding gray-banded kingsnakes (*L. alterna*). The hatching of fertile eggs of this species was very low, with a large percentage of deformed young being produced. We started supplementing the adult females with Rep Cal calcium and vitamin D₃ on a bimonthly basis. The hatch rate of fertile eggs increased dramatically; however, the percentage of egg fertility did not increase. To this day, we still use supplementation for food items provided to gray-banded kingsnakes, and we no longer experience large numbers of dead and/or deformed young. We have also tried supplementing food items for other species, including Sonora mountain kingsnakes and milk snakes, but have not experienced any increase in fertility or hatch rate.

Snake Reproduction in Captivity

For reproduction to successfully occur, the keeper obviously must have breeding pairs. Sexing colubrid snakes is fairly straightforward. Males have longer tails that are tapered; females have shorter tails with a more dramatic drop off after the vent. The females' tails will not have the "filled out" appearance of the males' tails, in similarly sized animals. Probing is the most useful method for determining the sex of a snake. This strategy employs a blunt narrow probe specially designed for sex determination of snakes. The probe is gently forced into the pocket of the vent on either the right or left side toward the end of the tail. However, this method should only be used by someone well versed in its correct procedure. In males, the probe will often go into the tail ten subcaudals; in females it should be much less.

After the winter cooling, we feed our snakes a few times and wait for them to shed before introducing the male and female snakes to each other. Depending on the species, we introduce the animals to one another from the middle of March through early July by placing the females into the males' enclosures. Our common kingsnakes, Sonora mountain kingsnakes and corn snakes usually breed during March, April or early May. Our gray-banded kingsnakes, gray rat snakes, Baird's rat snakes and Mexican

milk snakes usually breed during April and May. Finally, our Sinaloan milk snakes and Trans Pecos rat snakes breed during May, June, July and occasionally August! With the latter group of snakes, we sometimes have eggs hatching in mid-December! In colubrid collections around the country, this time frame is often shifted earlier by two months or more. Whether this is the result of these keepers warming up their animals sooner after the winter cooling period, or the fact that these people live in a lower latitude, is uncertain.

If the timing for breeding is correct, the male and female will exhibit a ritualistic sequence of events when placed together. Colubrid snake reproduction has been well-described and documented elsewhere (Brecke, et al., 1977; Murphy, et al., 1978). Typically, the male will court the female for a period of between several minutes and 30 minutes. During this time, he will rub his chin along the back of the female. If the female is receptive, she will allow copulation. This usually lasts for three to 30 minutes, although we have had Sonora black kingsnakes (*Lampropeltis getula nigrita*) breed for 30 hours!

Once the female has bred, we check a sample of fluid from her cloaca. If there is a lot of motile sperm in the sample, we assume that it was a good breeding. If there is no sperm, or large numbers of non-motile sperm, we use a "back up" male to breed the female. After a few days, we will again allow the female to breed with the fertile male. This ensures that the female's receptive period is at its peak during the breeding. Gravid females will noticeably swell up posteriorly during the next few weeks as eggs develop. At this time, eggs can be felt in her abdomen, although in recent years we have stopped palpating the eggs because we felt possible harm could be done to the very delicate developing eggs.

Ten to fourteen days before oviposition, the female undergoes a pre-egg-laying shed. At the time of this shed, we provide a nest box. This nest box consists of a plastic container with a hole cut in the top that is at least twice the diameter of the female. Inside the nest box are damp paper towels. We use paper towels because they are easily replaced. In the past, we used sand, but

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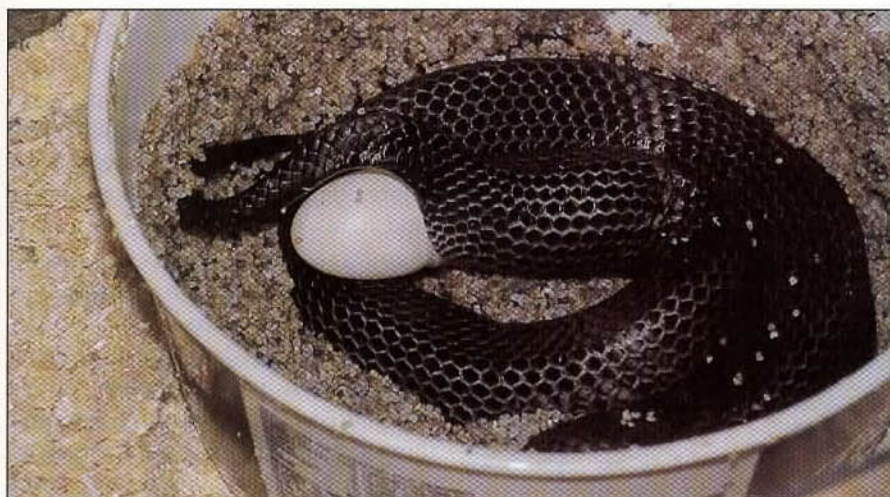
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this has caused problems for some females. Females who dig around in the sand incessantly prior to egg laying can sustain severe nose abrasions. Paper toweling will not cause these problems. However, care should be exercised to ensure the toweling does not dry out. Usually, a few days before she lays her eggs, the female will restlessly move about her enclosure. When we see this behavior, we double check the moisture content of the paper toweling. It is also important to check the female regularly, because we have had several incidents where the female has laid her eggs outside the nest box. If we had not been there to recover the eggs in a timely manner, they would have desiccated. Once the eggs are laid, they are placed in shoe boxes with vermiculite mixed with spring water at a ratio of 1:1, by weight. This formula does not necessarily need to be precisely followed, as we have successfully hatched eggs when the ratio of the components of the substrate was not exactly 1:1. Our eggs are incubated at a temperature of 82 degrees Fahrenheit (28 degrees Celsius).

There has been no definitive evidence to indicate that the sex of hatchlings is determined by incubation temperature (as is the case for some lizards and chelonians). We have had wide discrepancies in the sex ratios of our hatchling snakes. That is, sometimes our clutches hatch out with a much greater percentage of female neonates in comparison to male neonates, or vice versa. However, if we average all clutches over the past 20 years, our numbers do approximate a 1:1 male-to-female sex ratio.

After egg-laying, female colubrids often are emaciated. This time of the year is very important. If the keeper does not provide enough food for the female to replenish her drained energy reserves, she may not be ready to reproduce the following season or, worse, she may perish. We feed our females large numbers of smaller food items at this time. Again, the smaller items seem to be more easily digested. Sometimes, if the female is healthy enough and has adequate energy reserves, she may produce a second clutch. In our collection, the second clutch is usually smaller, with fewer numbers of eggs going full term.



Gerold Merker

This Sonora black kingsnake (*Lampropeltis getula nigrita*) is in the process of laying an egg. The eggs are very soft and rubbery when first coming out of the female. After a few hours on the incubating medium, the eggs become more rigid. During development, eggs do increase in size. Shortly before hatching, the eggs usually become softer with indentations on some of the eggs in the clutch. The authors use this occurrence as a cue to start preparing for baby snakes.



Gerold Merker

Here is a Baird's rat snake (*Elaphe bairdi*) laying a clutch of eggs. Currently, the authors use damp paper towels or damp Care Fresh in the nest box instead of the very abrasive sand.

Care of Neonates

Our baby colubrids are maintained in a shoe box rack with heating at the back of the cages. The front of the cages is kept at room temperature (75 degrees Fahrenheit [24 degrees Celsius]) during spring, summer and fall. We use paper towels as substrate, with a small water dish.

Provision of water is essential at this time, because such small animals easily dehydrate. All neonate colubrid snakes will undergo a post-hatch shed within two weeks of hatching. Prior to this shed, we keep a moistened, crumpled

paper towel in with the neonates to allow for easy shedding. We have never had a baby colubrid feed prior to undergoing this shed.

Inducing baby snakes to feed is often the most challenging aspect of colubrid breeding. Many neonate colubrids are very small, weighing less than 8 grams. It is very difficult for some to engulf a pink mouse of approximately 1 gram. Many simply will not take a meal without some type of "food altering" on our part. These tricks usually involve scenting a brand new pink mouse with a lizard or using a lizard to "prime" the



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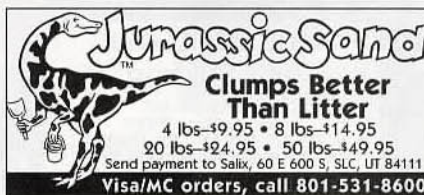
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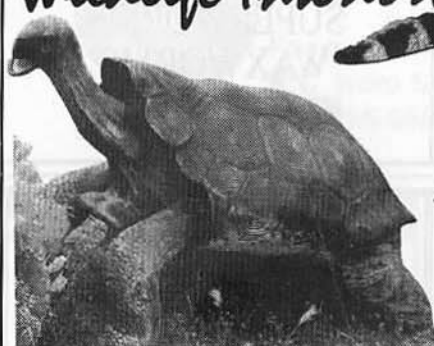
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snake and then offering a lizard-scented pink mouse. Another strategy that we use is to let the neonate become hungry. With a difficult feeder, we sometimes wait up to five weeks before offering the baby snake another food item. This extra time will often encourage the snake to feed. We employ this strategy only with snakes that are not emaciated.

Force feeding should be utilized as the last resort, when all other options have failed. This procedure is something that should only be performed by someone who has had experience with force feeding. Several strategies work well with force feeding snakes. One of these simply involves force feeding the tail of an adult mouse into the snake's gullet. The advantage of this type of force feeding is that the mouse tail can easily be manipulated into the snake's gullet because of its serpentine shape. The mouse tail is placed into water to allow for adequate lubrication and gently forced into the mouth of the snake. A twisting motion of the mouse tail gently forces it into the esophagus. The disadvantage of the mouse tail is its lack of total nutrition. The second tool many snake breeders use is the pinky pump or press. Several different models of this instrument are available through classified ads in REPTILES and other herpetological magazines. They all have their advantages and disadvantages. All models force macerated pink mouse into the snake's gullet. Dead pink mice are placed into a syringe-like tube and forced into the snake's stomach after being macerated by the pump's internal sieve. Care must be exercised not to "inject" the pink mouse too forcibly because of the potential for damaging the esophagus or stomach of the snake. Keep in mind that the esophagus is thinner than the plastic bags used to bag fruits and vegetables at the store (DeNardo, pers. comm.); it is very easy to destroy this tissue. Another important aspect of using the pinky press is adequate lubrication of the nozzle, or the part that goes into the snake's stomach, with water or egg.

The ability to raise newborn snakes to adulthood is the last step in the challenging process of successfully breeding snakes in captivity. As this cycle continues over the years, humans

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are assured of having healthy examples of their favorite snakes. At the same time, pressure on the natural habitat is decreased as healthy, beautiful, captive-bred animals become available for collections. Improved understanding of captive-breeding requirements can only lead to an improved status for threatened and endangered snake populations. At least there is the assurance that the animal will be able to thrive in captivity despite problems in the wild. As with other animals, snakes that are especially impacted by environmental toxins or habitat destruction may have their salvation in the understanding of captive reproduction. Different species have different requirements. As people specialize in their own animals of interest, they learn the individual requirements of those species. This information is being disseminated through clubs, conventions, books and magazines.

As the outlook for successful husbandry of different species improves, it makes us happy that over the past 20 years we have been able to learn from our mistakes. Our bedroom has long since become ours once again, and the snakes have a controlled room of their own. Hopefully, the knowledge we have gained will contribute to the well-being of captive snakes in the future. 🐍

We would like to thank the various people who have helped with this paper. Dr. Dale DeNardo kindly helped with many aspects of this paper. Walter Broda provided many of the ideas on how to induce neonate snakes to feed. Doug Brown helped with the photography. Finally, Jean Allured graciously lent us her editing skills.



Gerold Merker

The egg tooth on the end of the snout of this neonate Sinaloan milk snake (*Lampropeltis triangulum*) is used to cut the egg.

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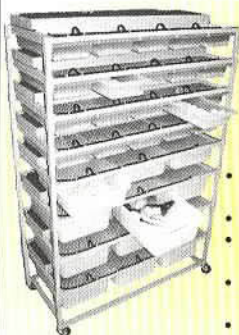
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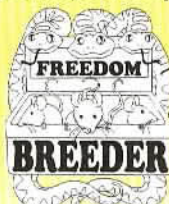


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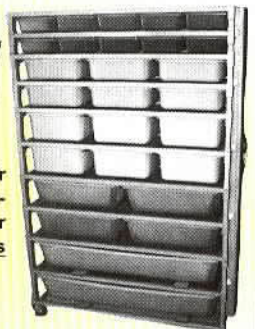
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