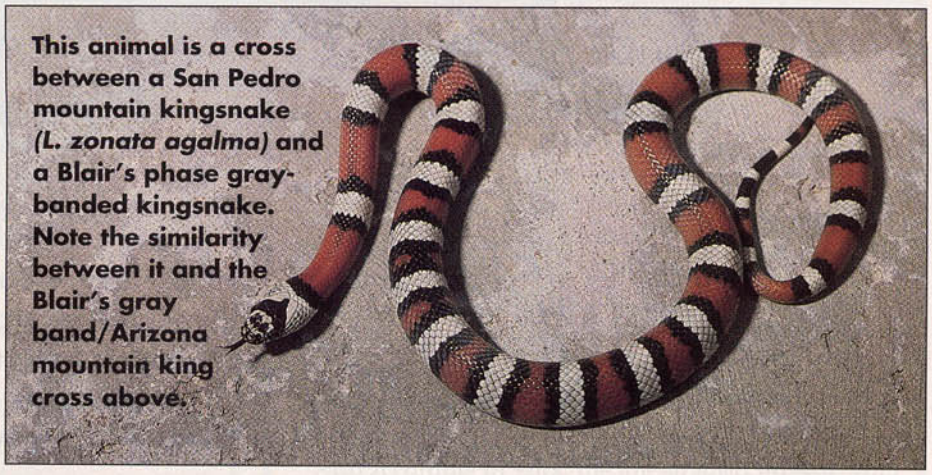
This snake is a cross between a Blair's phase gray-banded kingsnake *(Lampropeltis alterna)* and an Arizona mountain king *(L. p. pyromelana)*.

SNAKE HYBRIDS

An Interesting Way to Increase Diversity



This animal is a cross between a San Pedro mountain kingsnake *(L. zonata agalma)* and a Blair's phase gray-banded kingsnake. Note the similarity between it and the Blair's gray band/Arizona mountain king cross above.

On the left is a normal jungle corn; on the right is an amelanistic specimen.

I have always been intrigued by hybrid animals of any type. Perhaps it was just curiosity about the unusual, or a fascination with a children's cartoon I remember that paired up unusual combinations, such as an orange and a fur coat to prevent freezing, or a chicken with a centipede for a bevy of drumsticks. At any rate, I think hybrid animals—ligers, tions, zorses, beefalo and others—are interesting because they meld traits into organisms that have never been seen before. In this article, I'd like to impart my own experiences in hybridizing snakes.

This author believes hybridizing snakes is harmless, if carried out responsibly.

Story and Photos by Glenn Fankhauser

Throughout my school years, when I was being instilled with a love of reptiles by my father, I learned the patent definition of the word "species:" A group of interbreeding individuals of common ancestry that are reproductively isolated from all other such groups. At that time, it never occurred to me that it was possible for different snake species to interbreed. After all, we had just begun to breed them regularly, let alone propagate completely unrelated animals.

My curiosity first started to peak when I heard of naturally occurring hybrid snakes that had been collected in Ventura and San Diego counties (California) and were purported to be Pacific gopher snake and California kingsnake crosses. Genetic analyses later confirmed this fact.

Then I heard of breeders who had succeeded in producing gopher/kings, king/corns and even Durango kingsnake *(Lampropeltis mexicana greeri)* /Arizona mountain kingsnake *(L.p. pyromelana)* crosses. The most remarkable thing about these crosses was that some of the most impressive were intergeneric, rather than simply interspecific crosses. This meant that animals that were thought to be only distantly related were now breeding and producing viable and fertile offspring. This interested me because I thought they had larger implications in terms of evolutionary relationships. Rather than be surprised at the ability of different animals to interbreed, we should realize that they are much more closely related than we may have originally thought. Their ability to interbreed and produce fertile hybrids demonstrates that the different genera diverged from their common ancestor much more recently than we originally thought.

Early Attempts at Hybridizing

I first attempted an intergeneric cross of my own during the 1992 breeding season, using a male snow corn snake and a wild-caught female California kingsnake. Unfortunately, the only thing I succeeded in doing was getting the corn snake scarred up, due to the numerous attempts at ophidiophagy (snake eating) made by the kingsnake.

Hoping to increase my chances of a successful breeding, the next year I decided to use two captive-born animals on the assumption that I could lessen any natural aversion to crossbreeding that might be present in wild individuals. After numerous unsuccessful attempts at crossing the male snow corn snake with an aberrant amelanistic female kingsnake, I backed up the breeding with a male amelanistic California kingsnake. As a result of this breeding, I obtained nine eggs, five of which later proved infertile. During the incubation of the remaining four eggs, my father and I left on our annual gray-banded kingsnake collecting trip to west Texas. The eggs were due to hatch while we were gone, and my brother would be watching my animals for me.

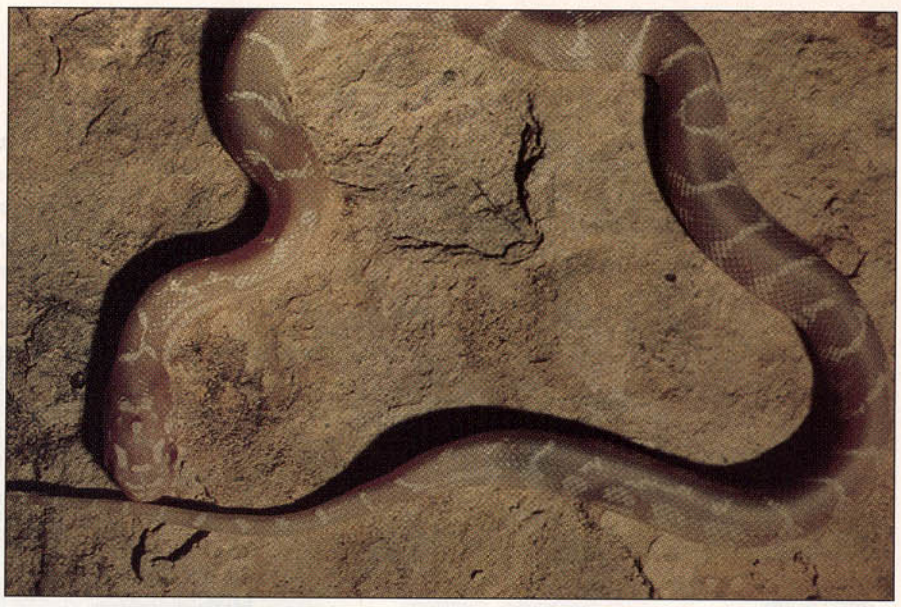
Knowing what I did about the genetics of different forms of amelanism that

had been seen in snakes before, I assumed that should the neonates hatch out as amelanistic, the cross would have been unsuccessful; should they hatch out normal colored, the cross would have been a success. Here is why I made this assumption: There have been several species of snakes in which amelanistic individuals have been captured or born from different areas of their range, resulting in more than one strain of amelanism. These include black rat snakes (red and white strain), Colombian boa constrictors, California kingsnakes (ruby-eyed and Balboa Park strains), San Diego gopher snakes (purple blotched and Applegate strains) and Sonoran gopher snakes (rusty amelanistic and amelanistic).

Occasionally, when these individuals mate, their offspring do not come out amelanistic, and thus a nonallelic form of amelanism occurs. Instead, the offspring are normal colored, but they carry the genes for both forms of amelanism; thus, they would be termed "double heteros." I assumed that because the two forms of amelanism with which I was working were from two snakes that were not even in the same genera, that surely the amelanism would not be carried at the same site on the genes. Indeed, I already knew that nonallelic amelanism can occur within the same species.

The eggs hatched while I was on my trip, and I called home to see what the results were. The heads were sticking out of the eggs, and the only thing I asked was whether or not they were amelanistic. My brother told me they were, and I spent the rest of my trip feeling disappointed that my cross had not been successful.

Upon my return, I put the snakes in separate cages and forgot about them. Then, when I was packaging them for sale, I noticed that their markings were different than they should have been; they had shades of red, yellow, etc. It was then that I realized my cross had worked, and I now had 2.1 amelanistic jungle corns. They demonstrated extreme hybrid vigor, growing faster than any snake I had ever owned, and despite the fact that they had been from a double clutching, they were able to breed during their second spring. The most amazing thing about this cross was the fact that the amelanism for these two genera—even though they originated on opposite coasts—was carried on the exact same loci of the chromosomes.



The author believes that this snow jungle corn is the first ever produced.

This snake is a Sinaloan milk snake *(L. triangulum sinaloae)*/California kingsnake *(L. getula californiae)* cross.

Working With Jungle Corns

In 1994, I attempted to replicate my experiment and successfully got three clutches of jungle corn eggs. In further hopes of demonstrating that the amelanism was carried on the same gene, one of the female kingsnakes I used was heterozygous for amelanism. Each of these clutches produced similar results, and the heterozygous clutch produced four amelanistic and five double hetero offspring—essentially what I would expect. I now had the ability to produce axanthic jungle corns from the double hets. (As a side note, for one of the female amelanistic kingsnakes that laid four eggs during this season, I had used an amelanistic male California kingsnake as a backup to the breedings. When the eggs hatched, three were jungle corns and the fourth was a striped amelanistic California kingsnake, proving that a given clutch of snakes can have differing parentage).

After the 1994 breeding season, I had produced only 10 amelanistic jungle corns. Since I was getting less than 50-percent fertility in the eggs that were laid, I was worried that the sperm and eggs were incompatible. I prepped

myself for the 1995 breeding season and was looking forward to being able to breed the amelanistic jungle corns I first produced in 1993.

The 1995 season proved to be my best, and I was able to get four complete clutches of jungle corn "F1" eggs (F1 meaning first generation; i.e., one parent was a king and one was a corn), and one small clutch of F2 eggs (meaning second generation eggs resulting from a jungle-corn-to-jungle-corn breeding). All the eggs from F1 clutches that I had seen to this date resembled kingsnake eggs in size, most probably because the eggs were produced by female kingsnakes. The eggs from the jungle corns themselves, however, were much smaller now that the corn snake genes could have some influence. The total number of eggs from this clutch was 12. Unfortunately, over the course of incubation, I ended up losing nine of them, which made me extremely depressed because I needed at least four eggs to have the proper percentages necessary to get a snow jungle corn, and I only had three. Needless to say, as hatching time drew nearer, things became more tense. The first two eggs slit the same day and were both normal amelanistics. Two days later, the last egg had still not slit, so I opened it myself, hoping not to find a dead embryo.

The first thing I noticed was that it was, indeed, a snow jungle corn. When I poked it, it reacted and I relaxed. Two days later, it was out and I was looking at what I believe was the first snow jungle corn ever to hatch.

Another interesting thing I noticed about these three hatchlings was that they displayed some degree of aberrancy. This demonstrated that during an intergeneric cross, the striped pattern of the kingsnake was hidden for one generation and appeared again in the F2 generation. The grandmother of these snakes was an aberrant individual, but neither of the parents were.

Ethics and Hybridization

There has generally been some resistance within the herpetological community with regard to snake hybridization. The outcry has mostly revolved around worries that these crosses will be released into the wild, harming those populations.

While this argument might have some merit, particularly in terms of subspecific crosses, the generic and specific crosses that are of greatest interest to the captive breeder most probably pose no such threat. Indeed, the bulk of these hybrids are between species that occupy completely different ecological niches, separated by several hundreds, if not thousands, of miles. Therefore, while any one individual might possess some traits that allow it to survive well in a particular habitat, it certainly would not have the full complement that an endemic species would possess, and would be easily outcompeted. Furthermore, most breeders are concerned with producing mutations, such as amelanistics, that would have additional hits against them in the wild.

A problem does arise when breeders approach hybridization from one of two other possible angles: subspecific intergradation and backcrossing. I believe every reputable herpetoculturalist should have objections to such inane hybridizations as Indian python *(P. m. molurus)*/Burmese python *(P.m. bivittatus)*, Burmese python/Sri Lankan python *(P. m. pimbura)*, or any hybridization between members of the *Lampropeltis zonata*, *L. triangulum* or *L. pyromelana* complexes. While some of these crosses may occur in wild populations, the incentive does exist for an unscrupulous reptile breeder or dealer to lump them into one of the subspecies, causing the unknowing buyer to purchase, breed and resell these animals under a new assumed identity. I suggest that if you ever see some animals such as these for sale, do not purchase them.

This snake is an example of backcrossing. A hybrid between an Arizona mountian kingsnake and a gray-banded kingsnake was bred back to a gray-banded king. As you can see, the result doesn't necessarily resemble either parent, but it should be noted that several of its siblings were indistinguishable from gray-banded kingsnakes.

Backcrossing animals, which I believe is certainly as grievous as subspecific intergradation, is sometimes done to get varying percentages of parental bloodlines. (An example of backcrossing would be if you were to take a jungle corn [*L. g. californiae*/ *E. g. guttata*] and breed it with one of its parental species, i.e., a pure California kingsnake or a pure corn snake.) I have made this mistake before, and have discovered that throwbacks to a parental line can occur as early as the second generation with 75- to 25-percent blood. Again, the danger here is that dishonest breeders may attempt to pass these animals off as the species with the dominant bloodline. There is also the greater possibility that these animals would be able to survive if released into the wild, as they possess more of the adapted genes. Even if the original breeder is honest as to what the bloodline of a given animal may be, there is no guarantee that others who buy these snakes and resell them will do likewise. Particularly in terms of amelanistic sports that can be crossbred to other species where there is not an ame-

OTHER CROSSES

Here is a listing of some of the crosses I have seen, bred or heard about:

THIS SNAKE	CROSSED WITH THIS SNAKE
Burmese Python *(Python molurus bivittatus)*	reticulated python *(P. reticulatus)*
Arizona mountain kingsnake *(Lampropeltis p. pyromelana)*	San Luis Potosi kingsnake *(L. m. mexicana)* gray-banded kingsnake *(L. alterna)* variable kingsnake *(L. m. thayeri)* Durango kingsnake *(L. m. greeri)* California mountain kingsnake *(L. zonata)*
California mountain kingsnake	gray-banded kingsnake
California kingsnake *(L. getula californiae)*	Pacific gopher snake *(Pituophis c. catenifer)* corn snake *(Elaphe g. guttata)* Sinaloan milk snake *(L. triangulum sinaloae)* gray-banded kingsnake
Pacific gopher snake	corn snake

It is interesting to note that so far only the Queretaro kingsnake *(L. ruthveni)* has been proven to interbreed successfully with all species of *Lampropeltis*. All of these crosses have so far proven to be fertile. (I'm not aware of any snake hybrid that has not been fertile.)

lanistic bloodline, what is to keep someone from saying they collected one of these amelanistics in the wild and claiming it is a purebred?

I think it's extremely important for breeders of crosses to keep accurate records as to parentage. I have talked to several breeders who don't even know what the genetics are of the neonates they are selling. They have told me things like, "Well, I know it's got some California mountain kingsnake in it—probably San Bernardino, I think—and some Durango and variable kingsnake, plus some Arizona mountain king. But it's mostly Blair's," or, "I don't know. I keep all my breeders together, so they could be anything." This type of thinking is what makes me fear the worst and start to rethink my position. However, I don't think most breeders are this negligent.

If you would like to attempt some of the crosses mentioned in this article, here are some suggestions:

1) Do not breed subspecies together.

2) Keep precise records of bloodlines.

3) If a cross is attempted with any *Lampropeltis getula* species, do not use a male *getula*. They tend to breed for longer periods, and can destroy a female's cloacal tissues if the female gets restless.

4) *Watch* the snakes. You don't want to open the cage two hours later to find only one very fat snake.

These are two snakes the author obtained at a reptile expo. They were sold as hybrids, but the breeder wasn't sure what type they were. While the two animals (presumably from the same clutch) look different from one another, an unscrupulous breeder could say the animal that's lacking red coloration is a gray-banded king and, although it has a lower band count, the other one is a Durango king *(L. mexicana greeri)*.

5) Don't do any backcrosses.

6) Remember: The most impressive animals are those that have equal ratios of bloodlines, such as 50-50, 25-25-25-25, or 12.5-12.5-12.5-12.5-12.5-12.5-12.5-12.5.

Good luck! By the way, I'd still like to see a rosy boa/rubber boa cross.

The author is interested in hearing from anyone who has seen or bred other types of crosses that he has not mentioned in this article. He can be reached by e-mail at Aspidites@aol.com; or you can write to him c/o Steven Sparks, Shriners Burn Institute, 815 Market St., Metabolism Unit, Galveston, TX 77550.