

RESPONSE OF INDIGO SNAKES TO GASSING OF THEIR DENS¹

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Abstract: The effects of gassing on the eastern indigo snake (*Drymarchon corais couperi*), an inhabitant of burrows of the gopher tortoise (*Gopherus polyphemus*) was tested in southern Georgia. Gassing is frequently practiced by rattlesnake hunters to drive snakes from tortoise burrows. Six adult indigo snakes equipped with radio transmitters had established typical winter behavior patterns before 3 of them were gassed 19 December 1979 with 60 ml of unleaded gasoline. The gassed snakes died between 12 and 34 days later. The ungasped snakes were recovered in excellent condition during January. Unusual behavior of gassed snakes preceding death is discussed.

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The prevalent practice of gassing burrows of the gopher tortoise to drive out eastern diamondback rattlesnakes (*Crotalus adamanteus*) has detrimental effects on several burrow inhabitants (Speake and Mount 1973). More than 30 vertebrate and many invertebrate species are known to use the burrows as dens to some extent (Allen and Neill 1951, Hubbard 1894, Hutt 1967, and Landers and Speake 1980). The threatened eastern indigo snake is 1 species that is apparently dependent on gopher tortoise burrows for winter survival in the northern part of its range (Speake et al. 1978).

Widespread concern exists among conservationists about the long-term effect of this gassing because of the organized "rattlesnake roundups" that are held in numerous localities. Prizes and publicity induce intensive winter rattlesnake hunting on sandhill areas where indigo snakes are concentrated in tortoise burrows. Speake and Mount (1973) observed that 2 of 3 indigo snakes died within 14 days and 1 survived for a month after being gassed.

The objectives of the present experiment were to obtain additional data on the effects of gassing and to test the response of indigo snakes to gassing under field conditions by using radio telemetry. The experiment was part of a larger study on the ecology of the eastern indigo snake supported by the Georgia Department of Natural Resources, Auburn University; the National Wildlife Federation and ITT Rayonier Corporation.

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METHODS

The study area is northeast of Tifton, Georgia, in the sandhills along the eastern side of the Alapaha River in Irwin County. The 2,835 ha tract, owned by ITT Rayonier Corporation, has been designated a snake sanctuary and research area. Habitat was once primarily longleaf pine (*Pinus palustris*)—scrub oak (*Quercus* spp.) that was clear-cut, mechanically site prepared, and planted to slash pine (*Pinus elliotii*) in the mid-1960's. The area is described in more detail by Speake et al. (1978).

Five of 6 adult indigo snakes were instrumented with temperature sensitive radio transmitters (Speake et al. 1979) and released on the study area 27 November 1979. An additional snake with a non-temperature sensitive transmitter was released on 5 December 1979. Four of these snakes had been captured on the study area and 2 had been captured on other areas in southern Georgia and northern Florida. Before gassing, all 6 snakes exhibited typical winter behavior (Speake et al. 1978) and all selected gopher tortoise burrows as dens. On 19 December 1979, after determining that the snakes were in their dens, 3 of the snakes were gassed. Gasoline fumes were administered by pouring 60 ml of unleaded gasoline into a long rubber hose that extended to the end of the burrow. Air was blown into the hose forcing the gas fumes into the dens. After gassing, all 6 snakes were monitored closely to compare movements, behavior, and body temperature (only 5 snakes).

RESULTS AND DISCUSSION

Gassed Snakes (Table 1)

Table 1. Fates of gassed and ungassed indigo snakes on the Alapaha Study Area, Georgia, December 1979.

Snake #	Sex	Length (cm)	Weight (kg)	Gassed	Fate	Days survived after gassing
91	M	216	2.3	X	Died	35
102	M	144	0.9	X	Died	12
94	M	173	1.4	X	Died	13
72	M	204	2.6		Breeding colony	
134	F	174	1.3		Released	
135	M	217	3.3		Breeding colony	

On the morning of 19 December, Snake No. 91 was located lying beside a gopher tortoise burrow at 1055 hours. He crawled back into the burrow and was gassed at 1100 hours, but did not emerge within 20 min so the observer left. At 1455 hours, the snake had emerged and was lying about 9 m from the burrow. The next morning at 0910 hours the snake was in another tortoise burrow 23 m from the gassed burrow. He was never located away from this den until 1 January 1980 when he was observed lying near the den entrance at 1200 hours. At 1555 hours that same day, he was coiled in the sun at the same location. On 2 January, the

snake was dug from the den because of transmitter failure and taken to the laboratory. The transmitter was removed and he was offered food frequently but refused to eat. He died on 22 January 1980. The snakes' average temperature for 6 den locations was 12.2 C. Outside the den in the sun his temperature was 22.8 C.

On 19 December, Snake No. 102 was located in a tortoise burrow and was gassed at 1015 hours. Ninety seconds after gassing the snake crawled slowly out of the burrow but did not appear groggy or abnormal. At 1530 hours, the snake was coiled in the sun 14 m from the gassing location and his body temperature was 26.1 C. On 20 December at 0849 hours the snake was coiled under grass 9 m from his previous location. The snake's body temperature was 2.2 C. and air temperature was 8.3 C. He could barely move and had obviously been there all night. At 1130 hours he was in the same location and his body temperature had warmed up to 13.3 C. At 1730 hours he had moved approximately 64 m and was again coiled under grass; his body temperature was 15.0 C. On 21 December at 1015 hours he was in the same location with a body temperature of 12.2 C. He was sluggish and not inclined to move. Several days later he was located in a windrow of site-preparation debris and then on 31 December 1979 was found dead coiled in the grass 183 m from the gassing location. He had been dead about 24 hours.

On 19 December Snake No. 94 was located in a gopher burrow and gassed at 0915 hours. The snake remained in this burrow until 31 December 1979 when he was found lying in a moribund condition in the mouth of the burrow. He was captured and died later the same day.

Necropsies were performed on the gassed snakes by the Auburn University School of Veterinary Medicine but the exact causes of death were not determined.

Ungassed Snakes (Table 1)

Snake No. 72 was located in 4 different gopher burrows and was detected outside the burrow twice. He moved about 0.54 km from the release site then entered and remained in 1 burrow where he was located from 13 December until 3 January 1980. He was recaptured 3 January 1980 and returned to the laboratory. The snake's average temperature was 17.8 C. while in the burrows and 21.6 C when outside the burrows.

Snake No. 134 was located in 9 different gopher burrows and made frequent, short movements from 1 den to another. She was recaptured 183 m from the release point on 4 January 1980. The snake's average temperature while denned was 18.9 C. No locations outside of dens were recorded.

Snake No. 135 used 6 different tortoise burrows and 1 windrow site as dens. He was located outside of a den or moving 4 times. The snake moved about 2.4 km in a rough semi-circle from the release site to the last location. On 19 December he moved into a gopher burrow and remained there until recaptured on 3 January 1980. His average temperature was 16.1 C in the dens and 17.2 C when outside the burrows.

All of the ungasped snakes exhibited normal behavior for indigo snakes during this time of year. They were in excellent condition when recaptured. The transmitters were removed and 2 are presently in the breeding colony at Auburn University. Number 134 was released in April 1980 as part of a restocking effort.

Each of the gassed snakes reacted differently to the administration of gasoline fumes. However, all 3 subsequently died apparently as a result of the gassing.

Gassed Snake No. 102 apparently became disoriented and did not return to the protection of a gopher burrow at night. This resulted in the snake nearly freezing to death. The denning temperature of Snake No. 91 was also considerably lower than that of any of the ungassed snakes. Because most of the gassing connected with rattlesnake hunting takes place in the winter, the practice could be lethal to the indigo snakes not only through asphyxiation or other direct effects but also by causing disorientation and inability to regulate body temperature. Management practices on areas where indigo snakes are present should include the prohibition of tortoise burrow gassing. Little is known about the exact physiological mechanism of death due to gassing, an area where additional research is needed.

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