Repelling Rat Snakes from Wood Duck Boxes with Chemical Barriers

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Abstract: Potential chemical repellents against rat snake (*Elaphe obsoleta*) depredation of wood duck (*Aix sponsa*) nesting boxes were tested under controlled conditions on the Rum Creek Wildlife Management Area, Georgia. Two repellents (Tack Trap and a mixture of Tack Trap and pine gum) effectively repelled rat snakes from wood duck nesting structures under pen conditions ($P<0.10$). The stickiness of the repellent material and not the presence of pinosylvin phenols appeared to be the deterrent to rat snakes.

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There is need for an inexpensive, effective means to repel arboreal snakes, such as rat snakes, from wood duck nesting boxes. The black rat snake (*E. obsoleta obsoleta*) and its close relative, the gray rat snake (*E. obsoleta spilodes*), are significant predators on wood duck nests. Johnson (1974) found that 80% of all wood duck clutches laid in boxes erected in Monroe County, Georgia, were destroyed by black rat snakes. McGilvrey (1968) cited the gray rat snakes as more destructive than the raccoon in Louisiana. Beshears (1974) related that gray rat snakes accounted for 40% of the unsuccessful wood duck nests in Alabama. Hansen (1971) found black rat snakes to be the greatest cause of nest destruction at Mingo Refuge in Southern Missouri. In the period between 1966 and 1969, rat snakes were the main predator on wood duck nests at the Yazoo National Wildlife Refuge, Mississippi (Strange et al. 1971).

A number of different metal predator guards have been designed to protect boxes including sandwich guards, inverted cones, bands, and flaps (Webster and Uhler 1964). The proper installation and care of nesting boxes and predator guards have been reported by a number of authors including Latimer (1961); Webster and Uhler (1964); and Almand (1970).

Such guards are usually costly and the results of their use have not always been satisfactory. Cronan (1957) found wood ducks appeared to favor boxes without predator guards. Strange et al. (1971) reported that sandwich

shields did not deter snakes from entering boxes. Odom (1970) found flap and conical shields ineffective in preventing rat snakes from entering wood duck boxes on the Piedmont National Wildlife Refuge, Georgia.

Little research has been done on efforts to chemically repel arboreal snakes from nesting boxes. However, recent studies involving the endangered red-cockaded woodpecker (*Picoides borealis*) have uncovered some promising avenues of further research.

Active nest cavities of this woodpecker species are usually identified by oozing pine gum (Robbins et al. 1966). The bird maintains a fresh flow of resin by pecking numerous small resin wells into the cambium (Jackson 1974). Chamberlain (1974) theorized that since 60% to 70% of red-cockaded nesting cavities face in a west or southwest direction, this may favor increased resin flow because of solar heat.

Ornithologists have long debated the role of this flow. Dennis (1971) stated that the primary function of the resin was that of protecting nesting and roost sites from arboreal snakes, as a tree coated with a smooth resin surface is probably invulnerable to tree climbing snakes. Jackson (1974) tested this hypothesis and concluded that pine gum did act as a repellent to arboreal snakes. He theorized that this repellency was due to the gum's stickiness and the presence of pinosylvin phenols, which may be toxic to snakes.

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Methods

During the 1978 and 1979 wood duck nesting season, potential chemical repellents (such as pinosylvin phenols in pine gum) against rat snake depredation of wood duck nesting boxes were tested on the Rum Creek Wildlife Management Area, Monroe County, Georgia. From March to April 1978, tests were conducted to ascertain the applicability of pine gum. The tests consisted of liberally spreading pine gum on dressed pine boards. These boards were then supported in a vertical position. All tests were conducted out-of-doors to simulate conditions that might be encountered if the materials were used to repel rat snakes from nesting boxes. Because the pine gum dried within only a few hours of application, it became apparent that an additive had to be found which would prevent the pine gum from drying. Materials tested included castor oil, petroleum jelly, Eucerin (a 50% water-in-oil emulsion of water, petrolatum, mineral oil, mineral wax, and wool wax alcohols manufactured by Beiesdorf Inc. of South Norwalk, Conn.); and Tack Trap (active ingredient: Polyisobutylene; manufactured by Animal Repellents Inc. of Griffin, Ga.).

Each of the materials was mixed with pine gum and liberally spread on

pine boards. Tests were run for approximately 18 days. Relative stickiness of the mixture was checked daily. Eucerin and pine gum and Tack Trap and pine gum were the two mixtures that appeared to have the most promise and were selected for further testing.

The testing of potential rat snake repellent mixtures and manner of application was conducted in 3 pens measuring approximately 2 m × 2 m × 2 m. Wood duck nesting boxes were erected in the center of each cage. Cages were checked 3 times daily when the location of each snake was recorded. If a snake was found in a box, it was removed and placed on the floor of the cage. Each day during the testing period, the position of the opening of each box was rotated 90°. Boxes were situated approximately 0.68 m from the side of each pen and 1.1 m above the floor of the pen.

To prevent snakes from climbing the sides of the pens instead of climbing up the poles, sheets of plastic were stapled to the sides of each pen. The plastic extended upwards from the floor of each pen approximately 1.1 m.

Table 1. Types of rat snake repellent tests conducted on the Rum Creek Wildlife Management Area, 1978.

Test	Nature of test	
I	No treatment. Designed to test frequency of visits of snakes to untreated boxes.	
		Length of Test: 10 days.
II	*Pen #1:*	Equal parts of Eucerin & pine gum applied to edge of box at beginning of experiment.
	Pen #2:	Two boxes present. Box A—post treated once with equal parts Eucerin & pine gum. Post support Box B treated daily with same mixture.
	Pen #3:	One box. Post treated with equal parts Eucerin & pine gum.
		Length of Test: 11 days.
III	*Pen #1:*	Top edge & around entrance hole and supporting structure treated with Eucerin only.
	Pen #2:	Box A—Eucerin spread on post and around entrance hole. Box B—Eucerin applied to post and around top edge and entrance of box.
	Pen #3:	Eucerin applied to top and around entrance of box.
		Length of Test: 14 days.
IV	*Pen #1:*	Top edge, post and area around entrance hole treated with Tack Trap.
	Pen #2:	Tack Trap placed around bottom edge of box.
	Pen #3:	Tack Trap was applied to the area around entrance hole and top.
		Length of Test: 14 days.
V	*Pen #1:*	Equal parts pine gum and Tack Trap were mixed and applied to post.
	Pen #2:	Tack Trap only placed on lid and post.
	Pen #3:	Tack Trap only on post.
		Length of Test: 14 days.

In 1978, 8 black rat snakes, ranging in size from 1.5 me to 1.54 m were captured and used in the tests. In 1979, 7 rat snakes ranging in size from 1.29 m to 1.62 m were used. The types of tests conducted in 1978 appear in Table 1. In 1979, the tests consisted of:

Test I. No treatment. Designed to ascertain the frequency of visits to untreated boxes. Length of test: 25 days.

Test II. Tack Trap was spread on the supporting pole in all 3 pens. Length of test: 24 days.

Test III. A mixture of 2 parts Tack Trap with 1 part pine gum was spread on all supporting structures. Length of test: 16 days.

All data collected were submitted to arcsin transformation and *t*-tests. In 1978, similar treatments were compared with untreated tests. A *t*-test was then made of the differences between the untreated tests and all other tests combined.

Results

When *t*-tests were made of the differences between the treated and untreated boxes and all other tests combined, the differences were not found to be significant ($P \geq 0.05$). The major reason for this lack of significance seemed to be the high variance in results. During the untreated test (1), snakes in Pen 2 were found in boxes located in Pens 1 and 3, 42% and 90%

Table 2. Results of 1978 rat snake repellent tests conducted at the Rum Creek Wildlife Management Area.

Test	Pen	Total snake checks	# Times snake in box	# Times snake out of box	Percentage in box	Arcsin
I	1	60	25	35	0.42	40.2
	2	60	8	52	0.13	21.4
	3	30	27	3	0.90	71.6
II	1	64	3	61	0.05	12.8
	2	62	3	59	0.05	12.7
	3	21	0	21	0.00	0.0
III	1	—[a]				
	2	82	10	72	0.12	20.4
	3	29	21	8	0.72	58.3
IV	1	74	12	62	0.16	23.7
	2	74	3	71	0.04	11.6
	3	62	6	56	0.10	18.1
V	1	80	6	74	0.08	15.9
	2	80	0	80	0.00	0.0
	3	80	0	80	0.00	0.0

[a] Insufficient data.

Table 3. Results of 1979 rat snake repellent tests conducted at the Rum Creek Wildlife Management Area.

Test	Pen	Opportunities	# Times snake in box	Percentage in box	Arcsin
I	1	140	02	0.01	6.80
	2	192	34	0.18	24.88
	3	142	21	0.15	22.62
II	1	110	00	0.00	0.00
	2	207	10	0.05	12.66
	3	138	02	0.01	6.80
III	1	45	00	0.01	4.44
	2	114	02	0.02	7.71
	3	81	00	0.00	0.00

of the time, respectively (Table 2). This meant that there was the need for a very large difference to prove significance. It was, therefore, concluded that the number of repellents tested be reduced and the number of replications for the tests be increased during the 1979 testing period (Table 3). Analysis of variance of the 1979 data showed a significant difference ($P < 0.10$, $F = 6.08$) between the untreated and the 2 treated values.

The proportion of the number of times snakes were encountered in boxes was compared with the times that they could have been found in boxes. These data were then analyzed with an arcsin transformation as were the 1978 data. There was high variability in these data. For example, snakes were found in boxes in Pen 1 during the first test only 1 of 140 times checked. This contrasted with snakes being found in boxes in Pens 2 and 3, 34 and 21 times, respectively. Such high variability precluded much chance of demonstrating significance between treatments with such small tests.

In conclusion, the evidence indicated that the 2 repellents tested in 1979 (Tack Trap alone and a mixture of 2 parts Tack Trap and 1 part pine gum) were effective when compared with no treatments. However, there was no evidence that significant differences exist between Tack Trap alone and the Tack Trap-Pine gum mixture.

Discussion

Both Tack Trap and pine gum were found to repel rat snakes. However, since no significant differences between these 2 repellents could be discerned, the value of mixing Tack Trap and pine gum for use as a repellent must be questioned. In addition, it appeared that the stickiness of the material and not the presence of pinosylvin phenols was a deterrent to rat snakes.

Tack Trap is fairly inexpensive, $23.95/gallon, but appears to be long-

lasting. Under field conditions, Tack Trap remained sticky for more than 1 year.

Snakes that became entangled in Tack Trap or Tack Trap mixtures were rendered almost completely immobile. During preliminary field tests, a number of small amphibians and invertebrates became entangled in the materials. Once small animals became entangled in the material, there appeared to be little possibility of escape. However, no evidence of wood duck entanglement was found. If the Tack Trap is confined to the post supporting the nesting box, there would be little chance of a wood duck encountering the repellent.

Since the completion of this project, Tack Trap has been experimentally used as a rat snake repellent on wood duck nesting structures on the West Point, Ocmulgee, and Rum Creek Wildlife Management Areas in central Georgia. Field observations indicate that Tack Trap can be used successfully in the field.

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