

## Road Mortality of Snakes in Central Virginia

Jason D. Gibson

Galileo Magnet High School  
Danville, Virginia 24541

Donald A. Merkle

Department of Natural Sciences  
Longwood University  
Farmville, Virginia 23909

### ABSTRACT

During the spring, summer, and early fall months, many snakes can be seen dead on roads. Few studies on snake road mortality have been conducted in Virginia. Between 1999 and 2001 we collected 109 DOR (dead on road) snakes representing 14 species in Powhatan County, Virginia. The eastern ratsnake (*Elaphe alleghaniensis*; n = 41) and the rough greensnake (*Opheodrys aestivus*; n = 18) were the most commonly collected snakes. One collected female *E. alleghaniensis* was found to contain eggs (n = 8). No observations of DOR snakes were made between December and March. Two distinct peaks in DOR snake collection were seen in May/June and September/October. June was the month with the highest recorded snake mortality with November being the month with the lowest.

*Key words:* Powhatan County, road mortality, snakes, vehicular traffic, Virginia.

### INTRODUCTION

Each year, snake populations decline as a result of habitat destruction and fragmentation, collection for the pet trade and rattlesnake roundups (Weir, 1992), killing by feral cats (Mitchell & Beck, 1992), and by road mortality (Dodd et al., 1989; Rosen & Lowe, 1994; Ashley & Robinson, 1996). Vehicular traffic has been estimated to kill 10's to 100's of millions of snakes each year in the United States (Rosen & Lowe, 1994). Each snake that is killed, whether by accident or deliberately, reduces the genetic diversity, decreases the potential for dispersal into fragmented habitats, diminishes the potential for reproduction, and lowers the overall population size.

Road cruising and collecting is a valuable tool used to study snake ecology and conservation. This method has been used to determine species negatively impacted by roads (Ashley & Robinson, 1996), relative abundance (Fitch, 1949; Clifford, 1976; Martin, 1976; Dodd et al., 1989), activity patterns (Price & LaPointe, 1990), physiology and behavior (Sullivan, 1981), population declines (Rosen & Lowe, 1994), and, of

local interest, distributional records for Virginia (e.g., Hobson & Stevenson, 1995; Gray & Wright, 1996; Roble & Hobson, 1997; Huber & Donahue, 2001).

Few studies have examined road mortality of snakes in Virginia (Clifford, 1976; Martin, 1976). The aim of this study was to document the diversity of species affected by road mortality, the relative abundance of species being affected, and to obtain natural history observations from the animals found killed.

### METHODS AND MATERIALS

This study was conducted in Powhatan County, Virginia. Habitats, natural features, and anthropogenic points of interest in this county have been described by Gibson (2001). The Virginia Department of Transportation maintains 80.5 km (50.0 miles) of primary roads, 354.4 km (220.2 miles) of hard surface secondary roads, and 61.7 km (38.3 miles) of non-hard surface roads (Jeff Caldwell, pers. comm.) in Powhatan County. US Route 60 is a major artery that leads to Chesterfield County and the City of Richmond from the west, and is used by 20,000 cars per day. Local

neighborhood roads in this rural county may have as many as 500 vehicle passes each day.

Road-killed snakes were collected from April 1999 to June 2001. A total of 391 road cruising days were conducted during this survey (1999 - 152 collecting days, 2000 - 174 collecting days, and 2001 - 65 collecting days). Most snakes were found along a 48 km (30 mile) route from County Route 1037 to 1 km west of the intersection of US Route 60 and US Route 522 between 0630 and 1530 h. The students of Pocahontas Middle School contributed a total of 21 snakes to this study. Dead snakes were identified, measured (nearest mm) for SVL (snout-vent length), TL (total length), and tail length, weighed (if the specimen was intact and freshly killed), and dissected for sexing and identification of prey items. For some specimens, measurements and sexing were not documented due to desiccation or destruction from vehicles.

## RESULTS

A total of 109 DOR (dead on road) snakes was collected during this study (Table 1 and Appendix 1).

Table 1. Summary of snake road mortality in Powhatan County, Virginia.

Species	1999	2000	2001	Total	%*
<i>Agkistrodon contortrix</i>	3	3	0	6	5.5
<i>Carphophis amoenus</i>	0	1	0	1	0.9
<i>Coluber constrictor</i>	5	5	4	14	12.8
<i>Elaphe alleganiensis</i>	16	16	9	41	37.6
<i>Elaphe guttata</i>	3	3	1	7	6.4
<i>Heterodon platirhinos</i>	2	2	1	5	4.6
<i>Lampropeltis calligaster</i>	3	1	1	5	4.6
<i>Lampropeltis getula</i>	0	0	1	1	0.9
<i>Nerodia sipedon</i>	2	1	1	4	3.7
<i>Opheodrys aestivus</i>	5	10	3	18	16.5
<i>Storeria dekayi</i>	1	0	1	2	1.8
<i>Storeria occipitomaculata</i>	0	0	2	2	1.8
<i>Thamnophis sauritus</i>	0	0	1	1	0.9
<i>Thamnophis sirtalis</i>	1	1	0	2	1.8
Total	41	43	25	109	100

\*Percent of total snakes

Of sixteen species recorded for Powhatan County (Linzey & Clifford, 1981; Tobey, 1985; Mitchell, 1994; Mitchell & Reay, 1999; Gibson, 2001), 14 species were found dead on roads. One species, *Thamnophis sauritus sauritus*, had not been previously recorded from this county. A voucher slide documenting this new county record has been deposited in the archives of the Virginia Herpetological Society at the Virginia Museum of Natural History. *Elaphe alleganiensis* and *Opheodrys aestivus* were the most commonly collected species, comprising over 54% of observed snakes. One female *E. alleganiensis* collected on 6 July 2000 yielded eight eggs upon dissection. This was the only snake observed to contain eggs. Consumed prey was only found in four snakes, including unidentified shrews (one each) that had been eaten by two *E. alleganiensis* collected on 8 May 2001, an unidentified juvenile snake consumed by a *Lampropeltis calligaster* collected on 4 October 2000, and an unidentified adult orthopteran that was preyed upon by an *Opheodrys aestivus* collected on 16 June 2000. No observations of DOR snakes were made in the months between December and March. June was the month with the highest number of DOR snakes with November being the month with the lowest (Fig. 1).

## DISCUSSION

Despite many hours of road cruising, three species of snakes known for Powhatan County (*Cemophora c. copei*, *Diadophis p. edwardsii*, and *Virginia valeriae*) were not found during this survey. *Diadophis p. edwardsii* and *V. valeriae* are small snakes and are often found only underground or beneath cover objects. These species may be less likely to be seen and killed on the road because of their habits and small size. In addition, scavengers probably remove smaller snakes faster than larger snakes. *Cemophora c. copei*, a third snake documented for Powhatan County but not found in this study appears to be rare (Table 2). Clifford (1976) and Martin (1976) found these three species to be generally lacking in their surveys of AOR (alive on road) and DOR snakes in Amelia County and the Blue Ridge Parkway and Skyline Drive, respectively.

A summary of monthly road mortality data for 1999 and 2000 reveals a bimodal occurrence of observed road-killed snakes (Fig. 1). This is consistent with important activity dates in snake life history. Snakes generally are more active during emergence from hibernation, mating and egg-laying periods, and migration to hibernacula. Observations from this study are similar to results obtained by Clifford (1976) in Amelia County.

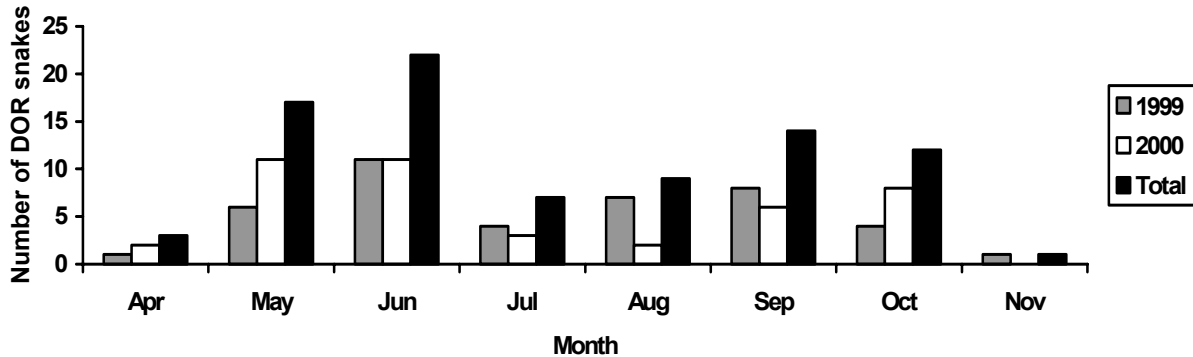


Fig. 1. Monthly summary of DOR snake observations in Powhatan County, Virginia, in 1999 and 2000. (Data was only collected for 65 days in 2001 and therefore is not included for comparison in this figure.)

Table 2. Relative abundance of DOR snakes in studies by Clifford (1976), Martin (1976), and Gibson & Merkle (this study).

Species	Total Clifford	Total Martin	Total this study	% Total Clifford	% Total Martin	% Total this study
<i>Agkistrodon contortrix</i>	17	243	6	6.1	44.6	5.5
<i>Carpophis amoenus</i>	21	5	1	7.5	0.9	0.9
<i>Cemophora coccinea</i>	1	0	0	0.4	0	0
<i>Coluber constrictor</i>	29	25	14	10.4	4.6	12.8
<i>Crotalus horridus</i>	0	69	0	0	12.7	0
<i>Diadophis punctatus</i>	1	15	0	0.4	2.8	0
<i>Elaphe alleganiensis</i>	105	76	41	38.0	13.9	37.6
<i>Elaphe guttata</i>	4	5	7	1.4	0.9	6.4
<i>Heterodon platirhinos</i>	24	14	5	8.6	2.6	4.6
<i>Lampropeltis calligaster</i>	10	0	5	3.6	0	4.6
<i>Lampropeltis getula</i>	6	1	1	2.2	0.2	0.9
<i>Lampropeltis triangulum</i>	1	31	0	0.4	5.7	0
<i>Nerodia sipedon</i>	16	3	4	5.8	0.6	3.7
<i>Opheodrys aestivus</i>	8	6	18	2.9	1.1	16.5
<i>Opheodrys vernalis</i>	0	14	0	0	2.6	0
<i>Storeria dekayi</i>	5	1	2	1.8	0.2	1.8
<i>Storeria occipitomaculata</i>	4	0	2	1.4	0	1.8
<i>Thamnophis sauritus</i>	2	2	1	0.7	0.4	0.9
<i>Thamnophis sirtalis</i>	20	35	2	7.2	6.4	1.8
<i>Virginia valeriae</i>	4	0	0	1.4	0	0
Total	278	545	109	100	100	100

Data on the relative abundance of a suite of species are important from both ecological and conservation perspectives. Relative abundance data for Virginia's snakes comes primarily from studies conducted by Clifford (1976) and Martin (1976). Clifford's four-year study used DOR snakes, snakes brought to him by county residents, and snakes he found in the field. Martin's three-year study consisted of snakes seen both AOR and DOR. A comparison of the present study with those of Clifford and Martin appears in Table 2.

Relative abundance data from Martin's observations and this study reveal many differences. These dissimilarities may be attributed to the respective study sites being in different physiographic provinces. Clifford's study occurred in Amelia County, which borders Powhatan County, and therefore has similar habitat, hydrology, and soil compositions. These two studies have very similar results when large diurnal snakes (*Coluber constrictor* and *Elaphe alleganiensis*) are compared. One striking difference is seen in the

data for *Ophedrys aestivus*. The cryptic nature of this species may have precluded Clifford from finding many in his field studies, thus accounting for its lower relative abundance in his study.

Road mortality may play a significant role in the decline of snake populations. Literature is generally lacking data for the effects that roads have on snake populations in Virginia. Although this study was limited to two years and 65 days, important data on diversity and relative abundance of affected species, as well as their seasonal activity periods, have been collected. More effort needs to be exerted to document the deleterious effects that some human practices are placing on the most diverse group of reptiles in Virginia. This effort and subsequent data will be useful for conservation planning to protect these unique creatures.

#### ACKNOWLEDGMENTS

The following students at Pocahontas Middle School provided specimens or locations of road-killed snakes: A. C. Clark, Stephen Dingus, John Dolen, Mackenzie Downtin, O. Fleming, Clay Gills, Logan Green, Kelly Hresan, Bubba Sing, Baylee Smith, Kira Stoyko, Matt Winfree, and Matt Zimmerman. Mike Clifford and William Martin graciously provided copies of their studies on relative snake abundance. Special thanks go to Dr. Steve Roble for providing copies of numerous articles on snake road mortality. John White, Joe Mitchell, Steve Roble, and an anonymous reviewer provided valuable corrections and comments on an early draft of this manuscript.

#### LITERATURE CITED

- Ashley, E. P., & J. T. Robinson. 1996. Road mortality of amphibians, reptiles and other wildlife on the Long Point Causeway, Lake Erie, Ontario. *Canadian Field-Naturalist* 110: 403-412.
- Clifford, M. J. 1976. Relative abundance and seasonal activity of snakes in Amelia County, Virginia. *Virginia Herpetological Society Bulletin* 79: 4-6.
- Dodd, C. K., Jr., K. M. Enge, & J. N. Stuart. 1989. Reptiles on highways in north-central Alabama. *Journal of Herpetology* 23: 197-200.
- Fitch, H. S. 1949. Road counts of snakes in western Louisiana. *Herpetologica* 5: 87-90.
- Gibson, J. D. 2001. Amphibians and reptiles of Powhatan County, Virginia. *Catesbeiana* 21: 3-28.
- Gray, W. P., & R. A. S. Wright. 1996. Field notes: *Heterodon platyrhinos*. *Catesbeiana* 16: 11-12.
- Hobson, C. S., & D. J. Stevenson. 1995. Field notes: *Thamnophis sirtalis sirtalis*. *Catesbeiana* 15: 23.
- Huber, F. C., & M. W. Donahue. 2001. Field notes: *Thamnophis sirtalis sirtalis*. *Catesbeiana* 21: 32-33.
- Linzey, D. W., & M. J. Clifford. 1981. Snakes of Virginia. University Press of Virginia, Charlottesville. 159 pp.
- Martin, W. H., III. 1976. Reptiles observed on the Skyline Drive and Blue Ridge Parkway, Va. *Virginia Herpetological Society Bulletin* 81: 1-3.
- Mitchell, J. C. 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, DC. 352 pp.
- Mitchell, J. C., & R. A. Beck. 1992. Free-ranging domestic cat predation on native vertebrates in rural and urban Virginia. *Virginia Journal of Science* 43: 197-207.
- Mitchell, J. C., & K. K. Reay. 1999. Atlas of Amphibians and Reptiles in Virginia. Special Publication Number 1, Virginia Department of Game and Inland Fisheries, Richmond, VA. 122 pp.
- Price, A., & J. L. LaPointe. 1990. Activity patterns of a Chihuahuan Desert snake community. *Annals of the Carnegie Museum* 59: 15-23.
- Roble, S. M., & C. S. Hobson. 1997. Field notes: *Regina septemvittata*. *Catesbeiana* 17: 21.
- Rosen, P. C., & C. H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of southern Arizona. *Biological Conservation* 68: 143-148.
- Sullivan, B. K. 1981. Observed differences in body temperature and associated behavior of four snake species. *Journal of Herpetology* 15: 245-246.
- Tobey, F. J. 1985. Virginia's Amphibians and Reptiles, A Distributional Survey. Virginia Herpetological Society, Purcellville, VA. 114 pp.
- Weir, J. 1992. The Sweetwater rattlesnake roundup; a case study in environmental ethics. *Conservation Biology* 6: 116-127.

## Appendix 1. Measurements and observations of DOR snakes in Powhatan County, Virginia, 1999-2001.

*Agkistrodon contortrix mokasen* (Northern copperhead)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
18 May 1999	232	41	273	9.1	Juvenile
3 July 1999	266	48	314	-	Juvenile
7 October 1999	205	40	245	-	Juvenile
21 May 2000	490	94	584	-	-
4 September 2000	-	-	-	-	-
5 October 2000	536	219	755	-	-

*Carphophis amoenus amoenus* (Eastern wormsneak)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
22 September 2000	226	40	266	-	-

*Coluber constrictor constrictor* (Northern black racer)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
27 June 1999	966	305	1271	-	-
27 June 1999	-	-	-	-	-
12 July 1999	1065	344	1409	-	Male
12 September 1999	747	251	922	-	-
28 September 1999	213	112	325	-	Juvenile
23 April 2000	921	294	1215	210	-
25 April 2000	1135	255	1390	-	-
16 May 2000	-	-	-	-	-
11 August 2000	-	-	-	-	-
6 October 2000	-	-	-	-	-
8 April 2001	649	220	869	-	-
23 April 2001	1067	265	1332	-	-
24 April 2001	-	-	-	-	-
9 May 2001	-	-	-	-	-

*Elaphe alleghaniensis* (Eastern ratsnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
10 April 1999	929	303	1232	290	-
5 May 1999	690	255	945	122	-
24 May 1999	-	-	-	-	-
25 May 1999	1270	257	1527	800	Male
11 June 1999	949	192	1141	-	-
27 June 1999	1138	225	1363	-	-
28 June 1999	986	209	1195	-	Male
28 June 1999	-	-	-	-	-
29 June 1999	714	150	864	-	Male
19 July 1999	863	182	1045	-	-
8 August 1999	1043	202	1245	-	-
23 August 1999	-	-	-	-	-
29 August 1999	-	-	-	-	-
21 September 1999	560	195	753	-	Male
28 September 1999	1078	193	1271	-	-
16 October 1999	1284	280	1564	-	Male
13 May 2000	-	-	-	-	-
18 May 2000	-	-	-	-	-
21 May 2000	872	190	1062	-	-
24 May 2000	1314	296	1610	-	Male

*Elaphe alleghaniensis* (continued)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
25 May 2000	-	-	-	-	-
25 May 2000	-	-	-	-	-
2 June 2000	-	1055	-	-	-
2 June 2000	-	-	-	-	-
3 June 2000	959	224	1183	-	-
7 June 2000	1110	223	1333	-	-
22 June 2000	-	-	-	-	-
1 July 2000	-	-	-	-	-
6 July 2000	1120	240	1360	-	Female
4 August 2000	-	-	-	-	-
5 October 2000	781	254	1035	-	Male
6 October 2000	-	-	-	-	-
8 October 2000	-	-	-	-	-
8 May 2001	995	208	1203	-	Male
8 May 2001	1015	160	1175	-	Female
13 May 2001	1092	192	1284	-	Male
22 May 2001	1078	97	1175	-	Female
2 June 2001	1061	214	1275	-	-
2 June 2001	1403	282	1685	-	-
4 June 2001	-	-	-	-	-
8 June 2001	-	-	-	-	-
23 June 2001					

*Elaphe guttata* (Cornsake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
18 May 1999	975	147	1122	340	-
8 August 1999	470	146	616	-	-
25 August 1999	-	-	-	-	-
15 May 2000	-	-	942	-	-
18 May 2000	-	-	-	-	-
18 July 2000	731	151	882	-	Female
28 April 2001	812	141	953	-	Female

*Heterodon platirhinos* (Eastern hog-nosed snake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Phase	Sex
10 May 1999	550	155	705	Melanistic	-
3 June 1999	308	59	367	Patterned	Male
14 May 2000	-	-	-	-	-
5 October 2000	211	30	241	Patterned	-
10 May 2001	543	99	642	Melanistic	-

*Lampropeltis calligaster rhombomaculata* (Mole kingsnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Dorsal blotches
2 June 1999	-	-	-	-
13 June 1999	-	-	-	-
8 August 1999	529	93	622	48
4 October 2000	319	56	375	54
4 May 2001	746	116	862	45

*Lampropeltis getula getula* (Common kingsnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
4 May 2001	1064	45	1109	-	Male

*Nerodia sipedon sipedon* (Northern watersnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
7 August 1999	-	-	-	-	-
7 September 1999	-	-	-	-	-
21 September 2000	171	63	234	-	Juvenile
6 June 2001	-	-	-	-	-

*Opheodrys aestivus* (Rough greensnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
3 July 1999	391	202	532	-	-
21 September 1999	371	212	603	-	-
21 September 1999	290	225	596	-	-
2 October 1999	270	172	462	-	Male
12 October 1999	423	265	688	-	Female
21 May 2000	415	190	605	-	-
3 June 2000	436	186	622	-	-
16 June 2000	332	220	552	-	Male
21 June 2000	-	-	-	-	-
23 June 2000	-	-	-	-	-
25 June 2000	391	250	641	-	-
20 September 2000	392	242	634	-	Male
21 September 2000	237	154	391	-	-
22 September 2000	317	116	433	-	Male
21 October 2000	491	272	763	-	-
24 April 2001	450	142	592	-	Male
3 May 2001	373	249	622	-	Male
11 May 2001	471	271	742	-	Female

*Storeria dekayi dekayi* (Northern brownsnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
3 November 1999	193	61	254	-	-
2 June 2001	250	68	318	-	-

*Storeria occipitomaculata occipitomaculata* (Northern red-bellied snake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
6 April 2001	-	-	207	-	-
6 June 2001	212	61	273	-	-

*Thamnophis sauritus sauritus* (Eastern ribbonsnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
13 April 2001	424	239	663	-	-

*Thamnophis sirtalis sirtalis* (Eastern gartersnake)

Collection Date	SVL (mm)	Tail Length (mm)	TL (mm)	Mass (g)	Sex
30 September 1999	253	68	321	21	Male
15 June 2000	324	91	415	-	-