Discovery of a Population of Scarlet Kingsnakes (*Lampropeltis triangulum elapsoides*) in the Virginia Piedmont

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The Scarlet Kingsnake, *Lampropeltis triangulum elapsoides* (Holbrook), has long been of interest to herpetologists because its brightly colored and strongly patterned appearance closely resembles, and apparently mimics (Pfennig et al., 2007), the venomous Harlequin (Eastern) Coralsnake (*Micrurus fulvius*). The Coralsnake has a black snout/forehead and broad, alternating black and red bands (= rings) separated by thinner yellow bands (hence, red and yellow bands touch), whereas the Scarlet Kingsnake has a red snout/forehead and broad red bands separated by three narrower bands (black, white/yellow, and black again; hence, red and yellow bands do not touch)(Conant and Collins, 1998). The colored bands of Scarlet Kingsnakes usually completely encircle the body, or at least partially cross the belly, whereas another similar, sympatric species, the Scarlet Snake (*Cemophora coccinea*), has a plain, whitish belly and pointed snout (Conant and Collins, 1998; Gibbons and Dorcas, 2005).

Holbrook (1838) originally described the Scarlet Kingsnake as a distinct species (*Coluber elapsoides*), and it was generally regarded as such for the next century. Blanchard (1920) described the subspecies *Lampropeltis elapsoides virginiana* based on specimens from North Carolina and Virginia, but Conant (1943) synonymized this taxon with the Coastal Plain Milksnake, *L. triangulum temporalis,* which has a purported range that extends from southern New Jersey to eastern Virginia (there are no milksnake records for the two Eastern Shore counties despite nearby records in eastern Maryland; Mitchell, 1994; Grogan and Forester, 1998) and extreme northeastern North Carolina (Wright and Wright, 1957; Conant, 1958). Williams (1978, 1988) subsequently concluded that *L. t. temporalis* did not merit recognition either, because he considered it to be the same taxon as the Eastern Milksnake (*L. t. triangulum*). For a more detailed summary of the *L. t. temporalis* situation, see Grogan and Forester

(1998), who have suggested that this subspecies should be recognized again. Conant (1943) was the first to present evidence suggesting that the Scarlet Kingsnake is a subspecies of the Eastern Milksnake. The situation became confused when some herpetologists applied the name *Lampropeltis doliata* (Linnaeus, 1766) to some or all North American milksnakes (e.g., Wright and Wright, 1957; Conant, 1958); this name actually referred to the Scarlet Snake, and its further usage was formally suppressed by a 1967 ruling of the International Commission of Zoological Nomenclature (Mitchell, 1994). Virtually all recent workers have followed Conant (1943) in using the name *Lampropeltis triangulum elapsoides* for the Scarlet Kingsnake (e.g., Williams 1978, 1988; Tobey, 1985; Mitchell, 1994; Palmer and Braswell, 1995; Conant and Collins, 1998; Gibbons and Dorcas, 2005).

Among several characters that distinguish *L. t. elapsoides* and *L. t. triangulum* are the presence of complete (or nearly so) bands (typically 14-20 red bands) encircling the body in the former and differences in the number of midbody scale rows (17-19 [usually 19] in *elapsoides* vs. 21-23 in *triangulum*) and ventral scale rows (fewer in *elapsoides*; 158-196 vs. 189-210) (Williams, 1978, 1988). Eastern Milksnakes typically possess a grayish brown snout, a Y or V shaped mark on the head, dorsal reddish blotches interspersed with smaller lateral blotches, and a checkerboard belly pattern (Conant and Collins, 1998).

The status of the Scarlet Kingsnake in Virginia has been debated for many years. Generalized range maps indicate this snake occurs in southeastern Virginia and also barely enters the southern Piedmont region of the state (Wright and Wright, 1957; Conant, 1958; Conant and Collins, 1998; Dorcas and Gibbons, 2005). The range map in Linzey and Clifford (1981/1995) suggests that Scarlet Kingsnakes are known from four Piedmont counties and six counties/cities in the Coastal Plain, and that intergrades with Eastern Milksnakes occur in 19 jurisdictions in the eastern and northern portions of the state. Tobey (1985) provided a separate map and account for the Scarlet Kingsnake, attributing all 14 locality records in the eastern Piedmont and Coastal Plain, south and east of a line from Mecklenburg to Lancaster County (after Williams, 1978) to this taxon, but noted that apparent intergrades exist and did not provide a clear delineation of range limits. He mentioned a juvenile photographed in the Great Dismal Swamp that closely resembled the Scarlet Kingsnake in pattern. In his detailed studies of North American milksnakes, Williams (1978, 1988) concluded that *L. t. elapsoides* and intergrades with *L. t. triangulum* are found in southeastern Virginia and northeastern North Carolina. He identified specimens from Mecklenburg County, Lancaster County, and the City of Virginia Beach as Scarlet Kingsnakes, but Mitchell (1994) considered these specimens as intergrades based on scale counts and pattern and concluded that *L. t. elapsoides* "should not be included in the Virginia checklist."

Mitchell (1994) stated that "*Lampropeltis triangulum* exhibits the most extreme geographic variation in body size, pattern, and color of any Virginia snake" and concluded that *L. t. triangulum* and intergrade populations with *L. t. elapsoides* were the only taxa of this complex present in the state. In the most recent Virginia herpetological atlas, Mitchell and Reay (1999) reiterated this conclusion. Mitchell (1994) further stated that "Snakes in the Coastal Plain and southeastern Piedmont more closely resemble the form [*elapsoides*] with encircling body bands" and his book also presented a photograph (Plate 45) of a completely ringed "intergrade" specimen from Southampton County. Martof et al. (1981) noted that these taxa were considered separate species for many years, but apparent intergrade zones existed in some areas of the Carolinas and Virginia. However, these authors also noted that both forms occur sympatrically in southwestern North Carolina without evidence of interbreeding. Palmer and Braswell (1995) determined that true *elapsoides* did not occur north of Pamlico Sound in North Carolina, and considered all specimens north and northeast of this estuary as intergrades with *L. t. triangulum*. In contrast, Armstrong et al. (2001) reported no interbreeding between populations of *L. t. elapsoides* and the Red Milksnake, *Lampropeltis t. syspila,* in western Kentucky and adjacent Tennessee. These authors noted that the aforementioned photograph, count data (scales and body rings), and statements in Mitchell (1994) led them to believe that the situation in Virginia might be similar to that in Kentucky (i.e., little or no interbreeding between purported subspecies of the same species). Armstrong et al. (2001) stressed the need to collect more data, especially from the southern Piedmont region of Virginia. More recent studies have revealed that the Scarlet Kingsnake is genetically different from and not especially closely related to the Eastern Milksnake, and merits recognition again as a full species (Harper, 2006; Harper et al., in prep.; G. R. Harper and W. L. Grogan, pers. comm.).

Harper and Pfennig (2006) and Pfennig et al. (2007) recently studied the Coralsnake mimicry complex that includes the Scarlet Kingsnake, and observed that mimic taxa vary in their resemblance to the model (i.e., Coralsnake) in different parts of their geographic range. The nearest populations of Coralsnakes to Virginia are in southeastern North Carolina (Palmer and Braswell, 1995); thus any Scarlet Kingsnake populations that occur in Virginia would be allopatric from and under less selective pressure than more southern (sympatric) populations to closely resemble the model. This might partially explain the presence of incompletely ringed specimens in Virginia.

The range map in Harper and Pfennig (2006) shows that Scarlet Kingsnakes extend farther north into the Piedmont of Virginia than had been previously illustrated, and also suggests that this taxon is absent from southeastern Virginia (but see footnote on page 92). Their northern range limit in Virginia is based on a population that two of us (GNW and MDK) discovered on 18 September 2003

while road cruising along County Route 608 (Tolers Ferry Road), a rural, lightly traveled road, in extreme southern Bedford County, east of Smith Mountain Lake and south of Huddleston. During the following three spring and early summer seasons (2004-2006), nine more Scarlet Kingsnakes were found crossing Route 608 in this area. All 10 snakes were found at night, typically between 2100 and 2300 h. Another specimen was found on this same road in June 2007 by Paul Sattler. Scarlet Kingsnakes are secretive and prefer pine forests (Martof et al., 1981) or mixed pine-hardwood habitats. They often hide beneath the loose bark of dead pine trees, especially during spring and fall (Gibbons and Dorcas, 2005). A diurnal search by Greg Woodie, Jason Gibson, and Paul Sattler during the summer of 2004 of one area of forest bordering County Route 608 failed to yield any additional Scarlet Kingsnakes.

Tissue samples from snake #6 below, as well as shed skins from several of the others currently in captivity were analyzed in the recent genetic study, and their identity as Scarlet Kingsnakes was confirmed (Harper, 2006; Harper et al., in prep.; G. R. Harper and W. L. Grogan, pers. comm.). This is a new county record and the first unequivocal report of Scarlet Kingsnakes from Virginia (Mitchell and Reay, 1999). Cumulatively, these records suggest that a thriving population inhabits southern Bedford County, and moreover, provide credence that earlier specimens from at least three other Piedmont counties (Albemarle, Appomattox, and Mecklenburg; Blanchard, 1920, 1921; Williams, 1978, 1988) were correctly assigned to this form (W. L. Grogan, pers. comm.).

The following is a chronological, annotated list of the Scarlet Kingsnakes that were found (all by Greg Woodie and Mike Kinsler, except #11) along a meandering, 6.0 mile (9.6 km) section of Route 608 in southern Bedford County (Fig. 1). None of the cross streets listed below is numbered on U.S. Geological Survey topographic maps or the DeLorme atlas map of Virginia. Elevations of the collection sites range from 750-1000 ft (229-305 m). The approximate center point of all sites (linear distance between the most northern and southern collections is ca. 4.2 mi [6.8 km]) is 37^{o} 02' 44" N, 79^{o} 29' 46" W.

1. Collected on 18 September 2003 near Teakwood Drive, about 1.3 km north of Toler's Bridge (Route 608 crossing of Leesville Lake [Roanoke River] at Bedford-Pittsylvania county line); 22 (total) white bands, slight break at midline of neck band; 15th band incomplete, being entirely absent on right side of body; 21 (total) red bands (Figs. 2B, 3H, 3J).

2. This snake was collected on 9 May 2004 near Moss Meadows Drive, about 3.3 km north of Toler's Bridge. It was hit by a truck after it was spotted on the road but before it could be retrieved, and died 2 days later. The specimen is deposited in the Liberty University Natural History Museum (#582). Mid-body

scale rows are 19, with 170 ventrals and 40 subcaudals. The belly is mostly white in the anterior portion and predominantly black posteriorly, with no complete ventral bands. All dorsal bands are complete, with the white ones (20 total) flared ventrolaterally; 20 red bands (Figs. 3B, 3K).

3. Collected on 13 May 2004 near Marcus Keller Lane, about 4 km north of Toler's Bridge; 22 white bands including a broad neck band, the 6th band is incomplete, being confined to the left side of the body; 21 red bands (Figs. 2D, 3A, 3G). Mid-body scale rows are 19, with 167 ventrals and 39 subcaudals; 160 mm total length (October 2005).

4. This snake was collected on 16 May 2004 near Timberland Trail, about 1.6 km southeast of the junction of County Routes 608 and 872.

5. Found on 5 June 2004 just north of the previous site; 24 white bands and 23 red bands, all sharply defined and complete dorsally (Fig. 2A; frontispiece, page 62).

6. This snake, which was collected on 23 June 2004 near Moss Meadows Drive, died in captivity and was frozen for use in the recent genetic study (Harper, 2006; Harper et al., in prep.). It is currently in the possession of Dr. George R. Harper, Hendrix College, Conway, Arkansas, who plans to donate it to the Virginia Museum of Natural History (G. R. Harper, pers. comm.).

7. Collected on 8 June 2005 north of Marcus Keller Lane; 23 white bands, including a partial neck band (right side only); 23 red bands (Fig. 3E). Mid-body scale rows are 19, with 169 ventrals and 38 subcaudals; 168 mm total length.

8. Collected on 12 June 2005, between 3.2 and 4.0 km north of Toler's Bridge.

9. This possible 2004 hatchling (95 mm total length) was captured on 21 June 2005 near Bettys Hill (Alta Lane), about 1.4 km southeast of the junction of County Routes 608 and 872; 24 white bands, neck band incomplete; 23 red bands; black bands are nearly complete on the venter (Figs. 3C, 3D, 3F, 3I).

10. Collected in April or May 2006 on Route 608 north of Toler's Bridge (exact date and location not recorded).

11. Paul Sattler collected this snake on 3 June 2007 "east of Smith Mountain Lake." It died in captivity and was deposited in the Liberty University Natural History Museum (#681). Midline scale count is 18; 23 white bands, all of which are quite wide; the 17th band is incomplete, being confined to the left side of the body; 22 red bands (Fig. 2C).

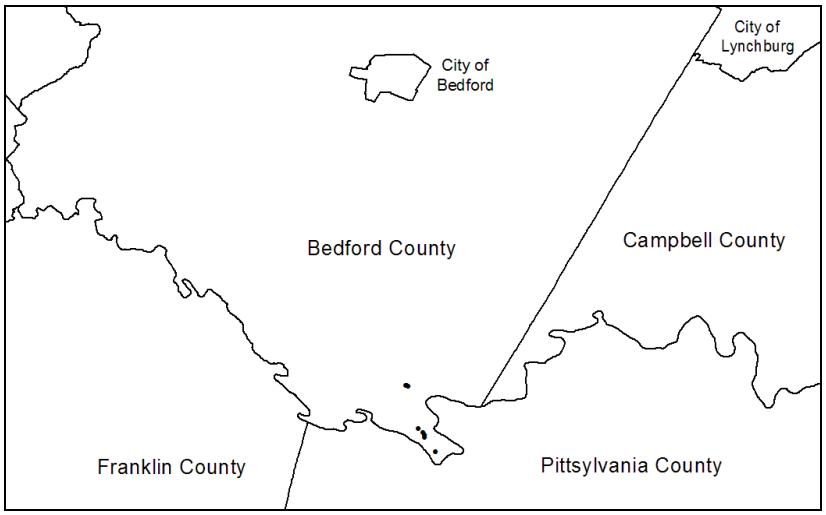

Fig. 1. Map showing approximate capture locations of Scarlet Kingsnakes in southern Bedford County, Virginia.

Fourteen other snake species were found by Greg Woodie and Mike Kinsler during road cruising along County Route 608 in Bedford County, including Wormsnake (*Carphophis amoenus*), Black Racer (*Coluber constrictor*), Ring-necked Snake (*Diadophis punctatus*), Eastern Ratsnake (*Elaphe alleghaniensis*), Cornsnake (*Elaphe guttata*), Northern Watersnake (*Nerodia sipedon*), Rough Greensnake (*Opheodrys aestivus*), Northern Brownsnake (*Storeria dekayi*), Northern Red-bellied Snake (*Storeria occipitomaculata*), Southeastern Crowned Snake (*Tantilla coronata*; n = 2), Eastern Gartersnake (*Thamnophis sirtalis*), Smooth Earthsnake (*Virginia valeriae*), Northern Copperhead (*Agkistrodon contortrix mokasen*), and Timber Rattlesnake (*Crotalus horridus*). Three of these species (both *Storeria* and *T. coronata*) have been reported previously from very near to but not within Bedford County (Linzey and Clifford, 1981/1995; Tobey, 1985; Mitchell, 1994; Mitchell and Reay, 1999); of these authors, only Linzey and Clifford reported *V. valeriae* from this county. No Eastern Milksnakes or Eastern Kingsnakes (*Lampropeltis g. getula*) have been observed along Route 608, but one possible Mole Kingsnake (*Lampropeltis calligaster rhombomaculata*) was noted.

The forests (mostly pine) bordering Route 608 in southern Bedford County are being increasingly threatened by residential development and logging. If the decision to upgrade the status of Scarlet Kingsnakes to full species is accepted by professional herpetological organizations such as the Society for the Study of Amphibians and Reptiles, then more attention should be paid to the conservation

Fig. 2. Scarlet Kingsnakes from Bedford County, Virginia: #1-B; #3-D; #5-A; #11-C. Photos by John White (A, B), Paul Sattler (C), and Greg Woodie/Mike Kinsler (D).

Fig. 3. Scarlet Kingsnakes from Bedford County, Virginia: #1-H, J; #2-B, K; #3-A, G; #7-E; #9-C, D, F, I. Photos by Greg Woodie and Mike Kinsler.

of this snake in Virginia. In one of the earliest attempts to identify the rare vertebrate fauna of Virginia, Russ (1973) suggested that the Scarlet Kingsnake was endangered in the state, but Tobey (1979) did not mention this snake in his review of endangered and threatened amphibians and reptiles of Virginia. However, in their review of the conservation status of Virginia's reptiles, Mitchell and Pague (1987) placed the Scarlet Kingsnake in the category "status undetermined" and noted that, due to secretive habits, it was likely more common in the state than the number of available specimen records (n = 7 at that time) indicated. This snake was not discussed in Mitchell's (1991) subsequent review of the rare (including status undetermined species) herpetofauna of Virginia. Currently, the Scarlet Kingsnake is not included on the list of "Species of Greatest Conservation Need" recently developed by the Virginia Department of Game and Inland Fisheries (http://www.bewildvirginia.org/species/reptiles.pdf). Mitchell (1994) remarked that the "intergrade" milksnake population in southeastern Virginia[1] was threatened with local extirpation due to urbanization and deforestation, and recommended the identification and protection of occupied habitats. This comment holds true for populations of Scarlet Kingsnakes in the Piedmont as well. All *Lampropeltis* specimens from southeastern and central Virginia that were previously regarded as intergrades should be re-examined in light of the results of the recent genetic study, and new material should be obtained for future genetic and morphological analyses to more accurately determine the distribution and status of Scarlet Kingsnakes (and Coastal Plain Milksnakes if this taxon is resurrected) in Virginia.

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[1]Several *Lampropeltis* specimens that were collected during 2006-2007 in the City of Chesapeake are putative Scarlet Kingsnakes based on morphological characters (W. L. Grogan, pers. comm.).

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