

## SNAKE USE OF URBAN HABITATS IN THE NEW JERSEY PINE BARRENS

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Several species of snakes in eastern North America thrive in or near cities where suitable, patchy habitat persists (e.g., Banta 1966; Collins and McDuffie 1972; Cook 1983; Minton 2001; Cook 2008). Increasing intensity of urbanization, however, causes species extirpations, exemplified by the loss of Copperheads (*Agkistrodon contortrix*) and Eastern Ratsnakes (*Elaphe alleghaniensis*) from New York City between 1900 and 1959 (Ditmars 1905; Kieran 1959). In contrast, small snakes such as Eastern Gartersnakes (*Thamnophis sirtalis*) and Northern Brown Snakes (*Storeria dekayi*) occasionally survive and even thrive in urbanized areas. Both have been called “city snakes” because populations are known to occur in highly urban environments, including Central Park in New York City and Clove Lakes Park in Staten Island, New York (Ditmars 1896; Pope 1946; Mathewson 1955; Kauffeld 1957; Schlauch 1978). Although some species may benefit from human disturbance because of the basking and foraging habitats they may provide (Zappalorti and Burger 1985), too much alteration and habitat loss leads to rapid population decline, especially for snakes with large activity ranges (Martin 1982; Brown 1993).

New Jersey has the highest human population density (436 individuals/km<sup>2</sup>) in the United States (Burger et al. 2007). The high rate of sprawl in southern NJ was reduced and controlled by the creation of the New Jersey Pinelands Commission (NJPC) that regulates development through legal measures in its Comprehensive Management Plan in cooperation with local, state, and federal governments (NJPC 1980). The Pinelands is the first U.S. National Reserve and a U.S. Biosphere Reserve of the UNESCO Man and the Biosphere Program (<http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?code=USA+43&mode=all>; accessed 10 February 2008). This internationally important ecological region is 445,164 ha in size and occupies 22% of New Jersey’s land area. Over

700,000 people live in Pinelands communities. Rural to urban gradients occur throughout the landscape and offer opportunities to evaluate snake use of urbanized areas. We summarize here 25 yrs of observations on snakes in this region and provide management recommendations that may benefit snakes in both urban and natural areas.

Methods used to gather information on urban snake behavior in the Pinelands fall into 4 general categories: homeowner nuisance calls, random opportunistic sampling, diurnal and nocturnal road cruising, and radio-tracking (Reinert 1992). Snakes were branded individually (Clark 1971) early in the study and subsequently PIT-tagged (Elbin and Burger 1994), sexed, weighed, and measured (Reinert and Zappalorti 1988a,b; Zappalorti and Reinert 1994). We captured snakes of suitable size for implantation of radio-transmitters. We standardized visual observations for consistency and assigned 1 of 6 behavior types or activities to each individual captured or observed: basking, foraging, courtship/mating, shedding, actively crawling, or concealed (Zappalorti and Reinert 1994).

### SPECIES OBSERVATIONS

*Coluber constrictor* — During the 25-yr study, 32 Black Racers were found crossing roads, or feeding near human dwellings, commercial buildings, and farmland out-buildings. Of these, 15 were found during the summer concealed under plywood or roofing metal in grassy fields, 11 were crawling across paved roads, and 2 were caught entangled in plastic netting (Stuart, et al 2001). Two had fed on Meadow Voles (*Microtus pennsylvanicum*), 1 regurgitated a White-footed Mouse (*Peromyscus leucopus*), and 1 was eating an *Opheodrys aestivus*. An adult female captured at a highly disturbed sand mining site in Cumberland County used successional fields, forest edges,

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abandoned buildings and an old Red Fox (*Vulpes vulpes*) burrow as a hibernaculum within her 31.0 ha activity range between 12 October 1995 and 10 October 2001.

*Crotalus horridus* — We observed 15 Timber Rattlesnakes within urban areas in Burlington and Ocean Counties during the 25-yr study. Of these, 4 were found dead on paved roads within residential areas between 1998 and 2004, 3 were found alive crossing paved or sand roads between July 1986 and August 2005, 2 were found coiled inside a pump-house at a Cranberry bog in August 2003, 1 was observed basking next to a backyard swimming pool in July 1987, 1 adult female was in a backyard garden but had been killed by the homeowner in August 2003. In August 2004, 2 adults were found in backyards in a Burlington County housing development, 1 large male was coiled on a driveway, and 1 male was stretched out on a cement patio.

*Elaphe alleghaniensis* — We recorded a total of 81 Eastern Ratsnakes in urban areas during the 25-yr study. Most of these observations were made in the summer months between 1980 and 2007. We found 12 crossing paved or sand roads in May or June, 14 were found concealed under plywood or sheet metal in July and August, 8 laid eggs in a hollow retaining wall made of railroad ties in June, 18 were hatchlings found on a railroad tie wall in September and during summer months 10 were basking on brush piles, tree limbs, or on the ground in backyards that bordered a large red maple swamp by a stream. Four snakes were found in an urban homeowner's basement. On 30 September 2003 within a 7-hr. period, during a site inspection to identify snakes that were alarming workers, we counted 26 *E. alleghaniensis*, five *C. constrictor*, three *T. sirtalis*, and two *S. dekayi*. These Eastern Ratsnakes and other species occupied the Water Quality Monitoring Station at DuPont's Repauno Plant in Gibbstown, Gloucester County, New Jersey. During summer months, many snakes were regularly seen in a building, on the concrete path, on a railroad tie retaining wall, and on a bridge. Because so many snakes were seen at one location on 30 September, we deduced that the railroad tie wall was a hibernaculum for *E. alleghaniensis* and *C. constrictor* at this urban location.

*Elaphe guttata* — We observed a total of 37 Cornsnakes in urban settings. Four were captured crossing paved or sand roads, 13 under plywood or sheet metal, 3 adults in a backyard trash dump, and 2 gravid females laying eggs in a hollow retaining wall made of railroad ties. Ten hatchlings were found under a hollow railroad tie along the edge of a driveway. Four recently shed skins were in a debris pile in an urban backyard. An adult female captured in April 1988 under a railroad tie on the New Jersey Audubon Society's Ocean County Wildlife Sanctuary illustrates snake movement patterns in an urban setting. She was fitted with a radio-transmitter and released at her capture point 3 d later. She remained at a large log and earth mound for about 2 weeks, migrated 0.6 km northeast

through pine-oak forest, and fed on White-footed Mice in a trash pile on the side of a sand road. Two days later she continued traveling northeast and was located in an Eastern Mole (*Scalopus aquaticus*) tunnel along the edge of a paved road, then crossed the road and continued traveling in an easterly direction for about 1800 m. She arrived at an old borrow pit on or about 1 June that had several piles of household trash. She remained hidden here for two weeks in Mole tunnels on the side of a large, grassy sand mound where she laid a clutch of 9 eggs. She then moved through Pitch Pine (*Pinus rigida*) forest 0.6 km northwest and was found hanging partially out of a cavity in a standing dead pine tree about 2 m above ground. Four days later she was 300 m north in a grassy field near a Senior Citizen Housing Development at the edge of the pine-oak forest. She moved through underground Mole tunnels or Meadow Vole runways under matted dry grass and remained there until 2 July. She was located on 5 July under vinyl siding of a house near the back door (where the rear of the building received rays from the afternoon sun). Closer inspection revealed a space in the wooden furring strip under the vinyl that was large enough for the snake to enter. Droppings of *P. leucopus* were evident below the hole. She remained in the wall for 8 d, then moved about 244 m south along the edge of the paved road, where she used a series of Mole tunnels on the grassy road shoulder. She moved south another 33 m during the following week, remaining underground in Mole tunnels close to the location where she had crossed the paved road on or about 30 May. She was killed on a paved road on or about 3 August 1988.

*Heterodon platirhinos* — Observations of Eastern Hog-nosed Snakes occurred between 1980 and 2005 in three Pine Barrens counties (Burlington, Cumberland and Ocean). Most were associated with homeowners calling about the "spreading adders" or "cobras" in their backyards. Four were observed feeding on *Bufo w. fowleri* in backyards, 2 were caught in plastic netting, 1 was crawling along the edge of a garage foundation, and 1 adult male was captured 4 times in a highly disturbed area in Cumberland County. This individual was recaptured under plywood in a successional field, crawling near a forest edge, crossing a sand road, and under tin by an abandoned building.

*Lampropeltis getula* — Five Eastern Kingsnakes were found in urban areas during the study. Of these, 1 was crossing a paved road in May 1988, 1 crawled on a sand road in June 1992, 1 was found concealed under a cement slab by a shed in a Toms River backyard in August 1995, 1 was basking in the rear of a yard in a brush pile in June 2000, and 1 adult was found eating an adult *Thamnophis sirtalis* on the side of a building in Jackson Township (Ocean County) in June 2005.

*Lampropeltis triangulum* — Of 7 Milksnakes encountered in urban areas, 2 were crossing paved roads in May and June of 1989, 2 were concealed under roofing shingles and flat ply-

wood in the summer of 1998 in a back yard, 1 was a gravid female found in the wall of a hunting cabin in May 1999, and 2 were basking in dry oak leaves on the edge of a baseball field at Mount Misery, in Burlington County, New Jersey in the fall of 1985. In the Pine Barrens, coastal plains milksnakes are often found hidden in human trash piles.

*Opheodrys aestivus* — Of our 6 observations of Rough Greensnakes found in urban habitats, 1 was a female in June 1987 laying eggs in a railroad tie that was used for landscaping by homeowners. The following year (June 1988) 1 clutch of 5 eggs was seen in a railroad tie used for landscaping. In addition, 1 clutch of 7 eggs was found in a hollow Sassafras Tree (*Sassafras albidum*) in a backyard, 2 adults were crawling across paved roads in September 2001, and 1 adult was observed being eaten by a large male *Coluber constrictor* near a patio in a backyard in August 2004.

*Pituophis melanoleucus* — Over the 25-yr study, 29 Northern Pinesnakes were observed in urban habitats. Of these, 9 were crossing roads during warm summer months, and 7 were concealed under plywood or sheet metal in urban back yards, mostly in May and June. In July 1992, 1 was in a window well in a backyard landscaped with ornamental shrubs and cultivated lawn. This home was adjacent to a stand of Pitch Pine and Scrub Oak (*Quercus ilicifolia*) along a sand ridge that comprised optimal habitat for these snakes in the Pinelands. One adult male was consuming 3 Red Squirrel (*Tamiasciurus hudsonicus*) pups in a birdhouse hanging from a Red Maple (*Acer rubrum*) tree in an urban backyard. Between 1984 and 1994, 5 gravid females were found laying eggs in open grassy areas in homeowner yards, while 6 others deposited their eggs on artificial snake dens, all in late June (Burger and Zappalorti 1986, 1991).

*Storeria dekayi* — During the summers of 2001 and 2002, we found 5 Northern Brownsnakes in city lots in western Burlington County where slugs and earthworms were abundant. Likewise, 2 were found under discarded plywood at the Water Quality Monitoring Station at DuPont's Repauno Plant in Gibbstown, Gloucester County, New Jersey.

*Storeria occipitomaculata* — Six Red-bellied Snakes were recorded in urban areas. We found 2 under an old wheel barrel in a homeowner's backyard, 2 others were under black plastic sheets placed on the ground to prevent weeds from growing in a garden, and 2 were concealed under discarded railroad ties in a backyard lot at the edge of a large housing development. These observations were made in Ocean County between the summers of 1985 and 1995.

*Thamnophis sauritus* — Three Ribbonsnakes were observed over the 25-yr study in urban settings. One adult male was seen crawling on a paved road lined with Red Maple (*Acer rubrum*), Black Gum (*Nyssa sylvatica*) and White Cedar (*Chamaecyparis*

*thyoides*) that crossed over Davenport Branch (Ocean County) in a Senior Citizen housing development in June 1986, and 1 adult female was found at the same location in May 1988. The stream under the road likely served as a corridor to protected state lands. A third large female was observed in July 1996 eating a small Green Frog (*Rana clamitans*) in a neighborhood back yard pond in the Bamber Lake region of Ocean County.

*Thamnophis sirtalis* — Several Eastern Gartersnakes were found feeding near residential or commercial buildings during the 25-yr study. Three were seen in 1987 at the Ocean County Airport concealed under plywood lying in a grassy field near the edge of an airplane hangar and had recently eaten Fowler's toads (*Bufo fowleri*). Two were observed in June 1991 on a paved road near a blueberry farm in the Chatsworth region of Burlington County (1 large male was observed alive, whereas the female had been run over and killed while crossing the road). Another Gartersnake (SVL ~ 65 cm) was removed from a garage in August 1992 at a senior citizen village in western Berkeley Township (Ocean County) and a large gravid female was found at the same location a year later. One adult male was observed in June 2005 being swallowed by an adult Eastern Kingsnake (*Lampropeltis getula*) on the side of a garage in Jackson Township, Ocean County. Another female *T. sirtalis* was seen in September 2006 at a senior citizen village in Berkeley Township, Ocean County; she had been caught in plastic netting placed over flowers to protect them from White-tailed Deer (*Odocoileus virginianus*) and Eastern Cottontails (*Sylvilagus floridanus*).

#### SUMMARY AND RECOMMENDATIONS

These observations demonstrate that snakes in the New Jersey Pinelands are able to exploit human-disturbed habitats in highly urbanized areas (Zappalorti and Burger 1985). Explanations for snake survival in such environments include: (1) riparian corridors within the snake's activity range that provide connectivity between suitable habitats, (2) high densities of prey at these locations, (3) human habitat features that provide sites for basking, shelter, and shedding, and (4) human-made hibernation or aestivation structures that inadvertently provide shelter which may be limited or absent in the nearby surrounding forest area.

Reptiles and amphibians often select edges between closed canopy forest and open fields or urban yards (Kjoss and Litvaitis 2001). Edge habitat provides thermal characteristics favorable to snakes, especially gravid females, and numerous prey. Lack of shade in edge habitat allows for a warmer microclimate, higher food availability, and suitable basking and egg laying sites. Natural openings in the Pinelands forest are rare and historically may have only been caused by lightning strikes or forest fires started by Native Americans (Stockton 1961; McCormack 1970). Most edge habitat(s) or old fields found in the Pinelands today are human-made by clear-cutting for tree harvest, farming, utility rights-of-way, or housing devel-

opments. Manipulation of edge habitat can provide suitable refugia for snakes and their prey, as long as stump piles, brush piles, and sand and log mounds are present and can serve as natural or artificial shelters.

Relatively simple measures can be taken in urban areas to enhance snake populations. These include creation of habitats that support invertebrate and rodent prey, provision of active season retreats, and avoiding stump removal or ground disking after tree harvest. Removal and careful use of horticultural netting would prevent entanglement and death of many snakes (e.g., Stuart et al. 2001; Mitchell et al. 2006a). Artificial dens have been used effectively in the Pinelands for endangered and threatened *E. guttata*, *P. melanoleucus*, and *C. horridus* (Frier and Zappalorti 1983; Zappalorti and Reinert 1994) and may be useful elsewhere. Other management recommendations in the Partners in Amphibian and Reptile Conservation (PARC) Habitat Management Guidelines (e.g., Kingsbury and Gibson 2002; Bailey et al. 2006; Mitchell et al. 2006b; www.PARC-Place.org) may be used in urban areas to enhance habitats that support snake populations.

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