

**Mark-recapture study of an isolated population of the
Mediterranean Gecko (*Hemidactylus turcicus*) in
Bedford County, Virginia.**

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In September 2006 a lizard was collected from the floor of a classroom at Liberty High School, Bedford, VA as the light was turned on in the early morning hours. This lizard was later identified as the Mediterranean gecko, *Hemidactylus turcicus*, an invasive species almost unknown in Virginia at the time. Additional specimens were observed and reported in Sattler et al. (2007). Liberty High School has been open since 1964 in rural Bedford County and geckos were first sighted there as early as 1988.

Earlier reports on populations of the Mediterranean gecko in Virginia include Knight (1993), Kleopfer et al. (2006) and Sattler et al. (2007). Fowler (1915) first described *H. turcicus* (from the Mediterranean) as *H. mabouia* (from West Africa) and his finding was later redescribed (Townsend et al., 2003) as the earliest record in the southern U.S., dating back to 1910. From that time additional records continued to be reported throughout the southeast (Meshaka et al., 2006) and west to California (Beaman et al., 2005). The most northern record of the species was reported by Norden and Norden (1991) from Baltimore, MD, approximately 333 km north of Bedford, VA. The closest known population of *H. turcicus* to the isolated population in Bedford is in Lynchburg, VA (Sattler et al., 2007), approximately 33 km east.

The purpose of this study was to investigate the ecology and natural history of this isolated population using mark-recapture methods. To this end data were gathered to (1) examine the relative abundance and distribution of *H. turcicus*, (2) examine the micro-distribution for patterns, and (3) examine reasons for the distribution such as refuges and lighting.

Previous observations indicated that an established breeding population existed at this site (Sattler et al., 2007), but it was not known how large the population was or the extent to which the Bedford campus was occupied. Few studies are available on *H. turcicus* life history traits (Punzo, 2001), and no detailed studies have been conducted to establish population densities or sex ratios in Virginia.

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Study site

This study was conducted on the campus of Liberty High School, in a rural environment adjacent to Bedford City, situated at the foot of the Blue Ridge Mountains near the Peaks of Otter. A majority of previous records (Meshaka et al., 2006) indicated that this species is more closely associated with urban environments, but rural environments have also been reported (Treadwell, 1962). It was unusual however, to find *H. turcicus* at a rural campus location situated away from the city near open fields and only a few homes. The buildings surveyed on campus are separated by 5–16 m and only the science building has sporadically placed bushes. The outer brick wall of the science building (the building covers about 1450 m²) was the primary focus of the mark-recapture study. Adjacent buildings include the gym, cafeteria, janitor's building, and shop. Preliminary sightings noted geckos in these buildings. The auditorium, two main academic buildings, library and office were not included in this study. The exterior of all buildings are constructed primarily of brick with the exception of the gym and cafeteria which have metal siding above the main outer brick wall surface.

Materials and Methods

The majority of observations and collections were from the outer walls of the one-story brick science building. Juvenile mark-recapture began in September 2007 and lasted into October 2007. These collections took place during the morning, afternoon, and early evening hours. Individuals were marked by toe-clipping following the example provided by Ferner (2007) with slight modifications. These toe-clip combinations provided sufficient options for the present and follow-up studies.

The concentrated efforts to estimate the population in the science building began on 17 June 2007 and ended on 3 July 2007 including a total of 11 mark-recapture events. Nocturnal surveying began at 2100 and ended around 0100 based on the peak activity hours reported by King (1959). The east side of the science building faces a parking lot. The north, south, and west walls faces the other buildings (gym, cafeteria, janitor's building, and shop) which were only used in a visual count survey.

A clockwise search pattern around the building was used each night, beginning in the back right east side of the building. A headlamp was used

to locate the geckos on dark walls and they were caught by hand or net on the wall. It was found that gently tapping the wall near lights usually encouraged geckos to emerge where they could be guided down with nets for hand capture. The geckos were immediately processed and released at the point of capture. Each gecko was given a unique mark (toe-clip). Additional measurements included snout-vent length (SVL) to the nearest mm (using a clear ruler) and weight in grams (using an Ohaus PS121 series field scale). Gender was recorded along with whether a female was gravid using the candling technique (Selcer, 1986). Males were determined by the presence of anal pores (Rose and Barbour, 1968). A map of the building was used to record the position of each gecko. The lighting varied from partial to full illumination on the east and west walls, partial illumination/total darkness on the south wall; and partial illumination on the north wall. The Schnabel (Smith and Smith, 2001) method was used to generate a population estimate based on mark-recapture results.

Results and Discussion

Based on the juvenile data collected fall 2007 and adult data collected summer 2008, a thriving breeding population exists at this site. The ratio of males to females slightly favored the females with 53.5% in a sample of 118 geckos collected and marked over 11 days. Most literature reports a 1:1 ratio (Punzo, 2001; Selcer, 1986; Rose and Barbour, 1968).

The SVL ranged from 22-61mm (Figure 1) and was broken into four cohorts based on Selcer (1986) and Saenz (1996). The mean SVL of the younger juveniles was 24.9mm, n=23; the mean SVL of the older juveniles was 33.75mm, n=12 (this is part of the group from the fall juvenile collection); the mean SVL of the second year individuals was 44.96mm, n=25; the mean SVL of the three plus year olds was 57.84mm, n=87. My captures were limited to the outer wall near the ground. It could be that the younger cohorts were primarily foraging in other parts of the building. However, females are noted to forage closer to the ground based on their stomach contents (Saenz, 1996) and this could account for a higher percentage in the number of females captured in this study. It was rare to capture a gecko observed on the top of the wall. At times they would run down the wall when approached, apparently going towards the light from the headlamp, making them more likely to be captured. Gomez-Zlater et al. (2006) stated that the light sources around the building are one of many

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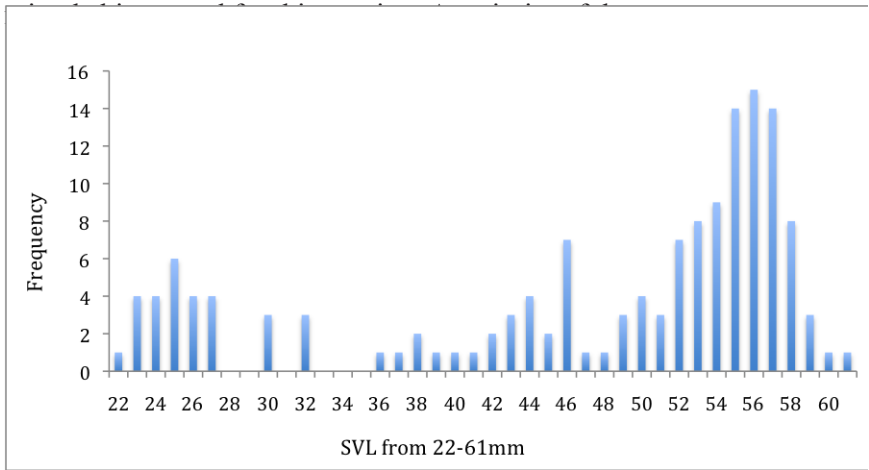


Figure 1. Observed Snout Vent Length Frequency - Cohorts fall into the following categories based on Saenz (1996): Young Juveniles <29 mm., Older Juveniles 30-39 mm., Second Year 40-49 mm., 3+ Year 50-61mm.

microhabitats used for this species. A majority of the geckos sighted were found up against or under the wall's light fixtures and could be observed making quick attacks on moths and other invertebrates and then rushing back to the shadows of the light fixture. Some geckos were found on the horizontal walls over door enclosures or the horizontal paneling surrounding many of the buildings, but the majority of the geckos were observed on vertical walls as described by Vogrin and Miklic (2005). The greatest abundance of geckos was found around the outer walls of the science building. These walls provided many retreats (cracks or holes), multiple doorways, vents, and lighting allowing the geckos to seek shelter (Luiselli and Capizzi, 1999).

The Schnabel estimate of the population size was 176 geckos in the science building. This estimate translated into 1213 geckos per hectare. This is similar to the reported size/ha of other studies (Selcer (1986) reported 544-2210 lizards/ha; Punzo (2001) reported 497-1463 lizards/ha). Adjacent buildings were observed to yield about half the total observed on the outer walls of the science building. The mean number of geckos counted per night was as follows: science=43.82; gym=21.29; cafeteria=17.29; janitor's building=19.43; shop=17.78. The number of recaptures per nightly survey ranged from 1 on the second night up to as many as 13.

The capture method of using nets on long poles and hand capture worked well. The success rate of capture was approximately 50%. Other methods that have been suggested and not tried at this site include rubber bands and squirt guns (Nelson and Carey, 1993). Investigation and development of more suitable catch/trapping methods may prove useful for a continued population study.

Many different types of refuges are utilized by this species. They are found to utilize objects around the building, openings in walls, or even piles of lumber (Dixon, 1958). It was observed that many geckos sought refuge behind objects that rested along the building walls or behind foliage that was up against the outer walls. Trash cans and crates were moved closer to the walls and the following nights these generally produced one or more geckos that used the objects for shelter during foraging. No geckos were seen moving about in the foliage, but one gecko on the south side of the gym was regularly seen on a pillar approximately 2 m away from the wall.

No predation on the geckos was observed during this summer survey, but potential predators were noted. A feral cat roamed around the buildings on several nights and potentially catches geckos (Punzo, 2001). Two toads and a gray tree frog were seen under the lights after days of heavy precipitation. The toads and gray tree frog were feeding, but it is uncertain if these have any effect on the gecko population. The only predation observed to date in this population was in the fall of 2007 where three juveniles were found caught in spider webs near the floor inside the science building. One juvenile that had been marked in the fall was found alive in a spider web with its left rear limb shriveled as it had been fed upon by a nearby spider. On all three occasions the geckos did not survive. Additional observed juvenile mortality resulted from the occasional gecko that was stepped on.

The degree of illumination around the building seemed to be an indicator of the abundance of geckos to be found foraging. The east and south walls of the science building, where the lighting was not as bright, yielded the greatest number of sightings, while the more illuminated walls on the north and west had the lowest numbers of geckos. Partial to full illumination yielded the fewest mean number of geckos observed each night (north $n=5$ and west walls $n=5$). The lighting was partial on the east wall ($n=19$) where the highest totals were observed. Complete darkness to partial lighting is

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found on the south wall (n=15) where the second highest mean number of geckos were collected and observed. This wall also contained a series of bushes along the base of a majority of the wall. The west and east walls had a few bushes and the north wall had none. As many as eight geckos were clumped around or under lights sources. Generally, two to three were found together around lights or they were found alone or in pairs on other parts of the wall. Frankenberg (1984) reports that this species is most commonly found in groups of no more than 3-5 individuals. It should be noted that the more illuminated walls had geckos foraging in full light and they could be found at all levels on the wall. As a generalist, these geckos would be expected to be found around the lights feeding on moths and beetles and closer to the ground feeding on more ground dwelling invertebrates (Saenz, 1996).

The dispersion pattern was expected to be clumped based on the lighting, but the west and north walls of the science building were close to having more random/uniform dispersion patterns. This could be a result of the lighting associated with those walls and lower overall mean numbers of geckos sighted during the survey on those walls.

It was previously reported that this population may have escaped from a terrarium (Sattler et al., 2007). It may be more likely that this population was founded from fruit imported annually from Florida for a fruit sale. Although this cannot be proven it could be tested by checking the source and various shipping locations for established gecko populations.

A main condition that seems to be limiting this species from moving further north is the availability of suitable refuge (Bauer, 2000). It is unknown if any members of this population reside totally inside the buildings. No foraging behavior has been observed inside. Geckos have been observed active in and around the buildings as late as December (juveniles) and as early as 1 January during cold temperatures (temperature during this time was around 4.4 °C). The limits based on the time for breeding and foraging also seem to be preventing this species from expansion (Meshaka, et al. 2006). Despite these limitations, it was found in this mark-recapture study that an established breeding population of the exotic species *H. turcicus* is thriving on the campus of Liberty High School.

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