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ABSTRACT: *Loxosceles rufescens* (Dufour), a relatively cosmopolitan, synanthropic species commonly known as the Mediterranean recluse spider, inhabits numerous government buildings in the Washington, D.C. area. Like the closely related brown recluse spider (*L. reclusa* Gertsch and Mulaik) in the south-central United States, *L. rufescens* can be extremely abundant within a structure. Unlike *L. reclusa*, D.C. populations of *L. rufescens* are essentially troglophilic, concentrated mainly in basements, foundation walls, and other man-made subterranean habitats, typically in close association with *Periplaneta americana* (L.) and/or *Reticulitermes* spp. It has not been observed either outdoors or in smaller, residential buildings. Since this spider is often misidentified as *L. reclusa* by entomologists who are unaware of *L. rufescens* widespread distribution and potential for persistent and dense local populations, we present photographs to aid in distinguishing the adults of these two similar species.

In recent years, we have become aware that the occurrence of *L. rufescens* in Washington, D.C. does not conform to the “single pinpoint” model, but rather is an area-wide phenomenon. This report has three objectives: 1) to document our observations of this spider and—considering the extreme (and often unjustified) medical notoriety of its genus—emphasize that its secretive behavior and the remoteness of its primary habitat ensures it is not a significant public health concern; 2) to publicize to the entomological and pest management communities in the United States that a synanthropic species of *Loxosceles* almost identical in appearance to *L. reclusa* is widespread and may potentially be encountered in a structural environment virtually anywhere in the country; 3) to assist non-arachnologists in distinguishing the two species.

Materials and Methods

Discovery of *L. rufescens* at all sites was an ancillary result of routine glue trap monitoring or visual inspections for other common structural pests by government or commercial pest management personnel. For reasons of security and confidentiality, specific buildings are identified only by numbers assigned in chronological order of spider discovery. Macrophotos of *L. rufescens* from Washington, D.C. and *L. reclusa* from Lenexa, KS were taken with the Auto-Montage™ system from Syncroscopy. Voucher specimens of *L. rufescens* from several collection sites have been deposited in the United States National Museum (USNM), Washington, D.C.
Results

Specimens of *L. rufescens* were obtained from 14 federal government buildings in the Washington, D.C. area during the 10-yr period from 1998 to 2007. Eleven of the structures are relatively close to the National Mall in the city’s downtown core, scattered throughout a rectangular area of about 4.0 km east-west and about 1.5 km north-south. Three additional buildings in which the spiders were found are located about 4.0, 4.5, and 6.0 km from the center of this core area. The greatest distance between buildings is about 9.0 km.

Basic characteristics of the collection sites are presented in Table 1. The buildings ranged in size from 1,250 to > 93,000 gross m$^2$ (≈13,460 to well over 1 million gross ft$^2$), and in age from 19 to 134 yr (≈74 yr). All but two sites involved areas either on the first floor (= ground level) or below. The exceptions were on the second and sixth floors. Habitat type varied widely and included offices (n=6); storage, utility, and mechanical rooms (n=10); and tunnels, chases, or crawl spaces (n=4) (several sites had more than one type of habitat where specimens were collected).

Initial detection of the spiders in eight of the buildings was by glue trap captures, typically involving only one or two specimens (Fig. 1). In the remaining six structures, detection was by chance observation of a single adult (n=3) or a single exuvia (n=3) (Fig. 2). Subsequent inspection at five sites revealed areas with numerous adults and immatures:

**Bldg. 1.** In 1998, specimens of *L. rufescens* were discovered on glue traps placed in two adjacent ground floor utility rooms to monitor for cockroaches (*Periplaneta americana* (L.) and *Supella longipalpa* (F.)) and ants. Dozens of adults and immatures were eventually captured on traps deployed at the door thresholds. In 2000, adult and immature spiders were collected together with *Reticulitermes* sp. workers behind a baseboard in a third room on the same floor. The baseboard, which was heavily damaged by the termites, had been removed for replacement.

No further spiders were recorded in this space following treatment with sprayed pyrethroids, and the rooms were subsequently eliminated in a major reconfiguration of the building. In December 2007 and January 2008, *L. rufescens* (primarily early-instar juveniles) began to be trapped on glue boards in four newly renovated mechanical rooms about 40 m away from the original site. Untrapped speci-
Bldg. 2. In spring 1999, *L. rufescens* were discovered on glue traps placed in basement office, utility, and mechanical rooms to monitor for *P. americana*. In October, an inspection was made of a short steam tunnel that connected to an adjacent building. About 18 m long and 1.5 m wide, the tunnel was filled with trash and debris such as doors, insulation, cardboard boxes, and cinder blocks (Fig. 4). Adult and immature spiders were extremely abundant on the unfinished masonry walls and cement floor, as well as in and under the debris. *P. americana* were also numerous, and several observations were made of *L. rufescens* feeding on nymphs (Fig. 5). The following month, much of the clutter was removed, vacuuming and extensive caulking were performed, and the tunnel was treated with sprayed pyrethrin and pyrethroid products as well as a pyrethrin/silica gel dust. Subsequent monitoring failed to detect any spiders for several months. Presently, an occasional specimen appears on glue traps maintained at the site.

Bldg. 5. In spring 2004, *L. rufescens* were discovered on glue traps placed in a basement storage area to monitor for *P. americana* and other pests. Additional traps deployed throughout the facility indicated that an adjacent switchgear room was a primary source of the specimens. Unlike the newer mechanical space in Bldg. 1, this room was not air-conditioned and had walls of the building’s original brick foundation (Fig. 6). Although the room was free of clutter, adults and immatures were flushed with a pyrethrin aerosol from cracks in the walls, beneath equipment, and behind sheets of plywood mounted on the walls to attach electrical panels.

A broader search revealed that the spiders had colonized two additional basement mechanical rooms and occasionally appeared on glue traps in several locations on the first floor. The number of specimens collected annually over the next 4 yr on about 30 glue traps maintained (and replaced as necessary) throughout the affected space were 33, 48, 37, and 14. Treatments with sprayed pyrethroids and pyrethrin/silica gel dust are carried out periodically to unoccupied areas where the spiders are most prevalent.

Bldg. 9. In June 2005, two adult males of *L. rufescens* were discovered on a glue trap placed in a ground floor room to monitor for *P. americana*. Numerous sow bugs (Isopoda) had also been captured on the trap. On 4 April 2007, during a brief inspection of a crawl space (= pipe basement) under the building, a single male *L. rufescens* was collected under a wooden box. The unventilated, unlighted space, measuring about 25 x 30 m, had unfinished walls of crumbling masonry and a dry dirt floor strewn with pieces of cardboard, rubble, and debris (Fig. 7). Many *P. americana* adults and older nymphs were observed, principally in the vicinity of leaking sewage pipes. Sections of termite-damaged structural wood were also present.

Six days later, an inspection of the crawl space specifically to search for *L. rufescens* confirmed that the spiders were extremely abundant and were readily observed under virtually every object that could be moved. On 3 May 2007, three people collecting for one hr captured 46 specimens: 28 immatures, 12 adult females, and 6 adult males. Many additional individuals, particularly very small immatures, were observed. Most of the latter were in or under material toward the center of the space; most adults were either in crevices in the walls or in concrete rubble next to the walls.

Two days afterwards, the crawl space was extensively treated with a microencapsulated pyrethroid spray. The applicators reported that the spiders were very numerous on the walls during the treatment. One month later (7 June 2007), no spiders had been captured on a series of 20 glue boards that had been placed one week after the spraying. However, by nearly three months after the treatment (29
August 2007), 17 spiders of all ages had been captured on 10 of the same traps.

**Bldg. 12.** This structure was originally built as a warehouse that was later converted to a vehicle maintenance facility. Its slab floor and block walls are in relatively poor condition, with numerous cracks and other damage. Although the presence of *L. rufescens* was first revealed by an adult female and very young immature on a glue board in a peripheral air-conditioned office, spiders were only found in abundance in a service bay used primarily for storage in the main, non-air-conditioned open area. Most individuals were under or behind boxes, debris, wooden pallets, and shelving. The first eight spiders observed during a 15-min period were collected; all were immatures. Occasional remains of *P. americana* were observed throughout the building.

**Discussion**

**Distribution, Habitat, and Behavior.** The occurrence of the Mediterranean recluse spider in the continental U.S. can be characterized as widely distributed but rarely encountered. In Gertsch and Ennik's (1983) survey of museum specimens, 65% (11/17) of the state records were represented by collections from a single locality; 23% (4/17) were represented by two localities, and 12% (2/17, Texas and Louisiana) by three localities. Multiple specimens were recorded in only 27% (7/26) of the total collection sites. Vetter's (2005) Internet offer to identify any U.S. spider perceived to be a brown recluse yielded only three specimens of *L. rufescens* from two states out of a total of 1,773 arachnid specimens from 49 states.

Much of our experience with *L. rufescens* in the Washington, D.C. area reflects this pattern in microcosm: at 79% (11/14) of the collection sites, the spider's presence was revealed by an initial discovery of only one or two specimens, either on a single glue trap or by observation of a nontrapped individual or an exuvia. All of these initial discoveries were a byproduct of routine inspections for other pests; in this regard, the well-known ability of glue traps to disclose the existence of infrequent or furtive arthropods was responsible for 57% (8/14) of the discoveries. In 64% (9/14) of the collection sites—i.e., all buildings other than those where numerous spiders were observed—either no further specimens (n=7) or a single additional specimen (n=2) have been collected (Table 1).

The prevalence of these types of records is curious, since populations of *Loxosceles* spp. tend to be extremely dense in favorable habitats. Abundance within structures is best known in *L. reclusa* and two synanthropic South American species, *L. laeta* (Nicolet) and *L. intermedia* Mello-Leitão (Hite et al. 1966, Schenone et al. 1970, Vetter and Barger 2002, Fischer and Vasconcellos-Neto 2005, Sandige and Hopwood 2005), but has been noted for *L. rufescens* as well (Vetter 2005, 2008).

Our observations of five Washington, D.C. sites where *L. rufescens* was plentiful suggest that one reason for the characteristically low numbers of collected specimens is because the species is strongly troglophilic in the urban environment. The two areas where adults and immatures were most numerous and readily observed with a minimum of habitat disturbance were a steam tunnel and a crawl space (Figs. 4 and 7) sharing the following features: 1) non-air-conditioned, rarely illuminated basement or sub-basement space that is physically secluded and inaccessible to all but a small number of personnel; 2) surrounded by a relatively old, deteriorating masonry foundation; 3) filled with stored or discarded items; and 4) occupied by American cockroaches and/or subterranean termites. Presenting a highly stable microclimate with an abundance of food and shelter, these anthropogenic “caverns” served as remote, subterranean breeding sites for populations that, except for immediately adjacent areas, exhibited relatively low levels of dispersal into the sections of the built environment where most human activity occurs.

The susceptibility to *L. rufescens* colonization of any sort of interior space contiguous with such primary population loci is demonstrated by the essentially barren (clutter-free) mechanical rooms at two other sites, none of which appear capable of supporting large numbers of any invertebrate. However, the basement switchgear and mechanical rooms of Bldg. 5 (Fig. 6) meet the first two conditions described above and are routinely invaded by *P. americana* from the surrounding infrastructure. The ground floor machine rooms of Bldg. 1 (Fig. 3) are far more microenvironmentally hostile, but constructed immediately over a steam tunnel that presumably is the source of the continuing *L. rufescens* immigration (as well as occasional specimens of *P. americana*). Warmth from the tunnel undoubtedly also accounted for the midwinter swarming of termite alates from beneath the floor slab.

With its high ceiling and extensive, open space, the garage that constitutes the fifth site of spider abundance is superficially distinct in appearance from the others. However, the infested storage bay shares some of the first condition as well as the second and third, with the structure’s poorly sealed envelope allowing entry of ample prey from outdoors in addition to the ubiquitous *P. americana*.

In fact, the discovery of *L. rufescens* in Washington, D.C. conforms to a new-familiar scenario for urban colonization by both this species and another anthropochorous (readily transported by man) congeners. In 1960, a single adult male of *L. laeta* was collected in the basement storage space of Harvard University’s Museum of Comparative Zoology in Cambridge, MA. After a second individual was found the following year, a systematic search revealed that the spiders were numerous

<table>
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<tr>
<th>Building</th>
<th>Year</th>
<th>Building Size</th>
<th>Building Age</th>
<th>Level</th>
<th>Specimens</th>
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<tr>
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<td>Basement</td>
<td>1 Exuvia</td>
</tr>
<tr>
<td>5</td>
<td>2004</td>
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<td>1st Floor &amp; Basement</td>
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</table>

*First year spiders were observed.*

*Gross m² (total area of all floors, including basement levels and vertical penetrations).*

*Building age at time of first spider observation.*

*1st floor = ground level; “Basement” = any floor below ground level.*

*Total collections through 2007. “Numerous” = abundant adults and immatures of all ages.*

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(with "loose boards, and cardboard or wood containers" as their preferred cover) and may well have been present for at least 20 yr. A fourth floor room had also been colonized (Levi and Spielman 1964). Nearly identical circumstances were described for a building at the University of Helsinki, Finland, in which, following sporadic collections of isolated L. laeta individuals for 8 yr; it was finally recognized that the entire ground floor and parts of the basement were infested (Huhta 1972). The most extensive example of long-term establishment of this species outside of its native range began in 1968 with the chance collection of a single individual from a building in a Los Angeles suburb (Waldron 1969, Hebert 1993). By 3 yr later, it had been documented in 127 buildings up to 18 km apart – twice as wide as the Washington, D.C. cluster. Based on dense accumulations of exuviae and webbing, the spider had evidently been present in the area for many years and could have been introduced “at any time during the history and growth” of southern California (Waldron et al. 1975).

Similar accounts of cryptic structural populations exist for L. rufescens. In December 1996, a single specimen was noticed on a glue trap in a ground floor storage room of a museum in Philadelphia, PA. Subsequent trapping revealed that the spiders were abundant in that room, adjacent switchgear space, and areas in the basement and the second floor. Steam conduits leading into the building were believed to be the source of the infestation, as well as an accompanying population of P. americana (V. Greene, personal communication). A parallel case of a long-standing L. rufescens colonization in a sub-basement and adjoining greenhouse that was revealed by a single collected individual was reported for a building on the Ohio State University campus in Columbus, OH (Berry and Venard 1970). Parker (2002) described additional infestations in basement habitats in Philadelphia and New York City.

It is noteworthy that, unlike L. reclusa, L. rufescens in North America has been almost exclusively associated with larger masonry buildings or their subterranean infrastructure. Vetter (2005) observed that “virtually all locales” of specimens sent to him “have been municipal, commercial, or university-related structures.” Gertsch and Ennik’s (1983) survey of collection sites in the continental U.S. specified 10 such buildings as opposed to one “house.” Other than records of single individuals discovered in shipped material (Mandon and Hall 1970, Unzicker 1972) and a specimen in the USNM collection from a home in Beltsville, MD, we are aware of only one instance where multiple specimens were found in a residential unit in the U.S. (a house in Florida and initially assumed to be L. reclusa – Harbison 2007a, 2007b). Almost the same constancy of niche is shown by L. laeta outside of its native range. Although the southern California population occasionally occupies attics as well as basement areas, the structures themselves are mostly older concrete and brick commercial buildings within business districts (Waldron et al. 1975, Hebert 1993).

Loxosceles colonization of cavern-like habitats has ample precedent: numerous species have been collected in and nearby natural caves, and there are several that are found nowhere else (Newlands 1975, Gertsch and Ennik 1983, Griffin 1998, Ferreira et al. 2005, Gonçalves-de-Andrade et al. 2007). L. rufescens in particular has shown a markedly troglphilic tendency throughout its range, and has gained notoriety for competing with (and apparently preying on) an endangered indigenous species of troglobitic wolf spider in volcanic caves on the Hawaiian island of Kauai (USFWS 2006). Moreover, L. rufescens on Kauai “has been observed to become a dominant member in caves where conditions appear to be sub-optimal (i.e., reduced relative humidity) for native cave-dwelling animals” (USFWS 2006). However, L. rufescens is also well documented as frequently occurring under cover in non-enclosed habitats as well, including in Hawaii (Gertsch and Ennik 1983). In Israel, in addition to the species being “fairly common in houses and cellars” (Shulov et al. 1960), it has also been reported as the dominant spider in two citrus groves, hiding in moist leaf litter and old egg cartons placed under trees to soften the fall of ripe fruit (Borkan et al. 1995). In Australia, it has been recorded as living beneath bark or under rocks as well as in residences (Brunet 2000), and on the island of Saint Helena it is found “under rocks in flax plantations” (Ashmole and Ashmole 2004).

It is therefore puzzling that such an adaptable species has thus far been apparently so constrained in its habitat throughout the warmer parts of North America, particularly in areas where there are no native Loxosceles that might serve as close competitors. There is only a single, anomalous record of an outdoor collection of L. rufescens in the U.S.: the holotype of L. marylandicus Muma, which was synonymized as L. rufescens by Gertsch (1958). Muma (1944) noted that the male specimen was “collected on a log, April 9, 1941” in College Park, Maryland. Local temperatures on that date rose to a maximum of 20.6°C (National Climatic Data Center, NOAA Satellite and Information Service, online data for College Park Weather Station), so there is no obvious meteorological reason why an individual could not have crawled to an exposed location. However, since this type of site has not been recorded elsewhere in the United States for L. rufescens, and since decades of intensive entomological collecting at College Park (which includes the University of Maryland campus) have failed to produce a second documented specimen, it is likely the account is not representative of normal L. rufescens behavior in this vicinity. Nevertheless, no systematic survey efforts have been carried out in the surrounding landscapes of buildings harboring L. rufescens; which might reveal dispersion into nonstructural microhabitats.

Considering the increasing rate of discovery of this spider in Washington, D.C. buildings over the past 10 yr, two additional questions come to mind. The first is whether these accumulating records reflect a relatively recent spread of L. rufescens throughout the city or are simply the result of a recently enhanced search image among pest management personnel. We assume the latter, and wish to emphasize the similarity of our delayed recognition of the spider’s abundance with previous accounts of L. rufescens and L. laeta discoveries in other locations cited earlier. In this regard, one of us (A.G.) observed what was apparently a live male L. rufescens in a Bldg. 5 stairwell in 1989, about 15 yr before its presence in that structure was positively confirmed by a glue trap capture. It should also be noted that the widespread use of glue traps by pest management personnel throughout the city only began in the early 1990’s, a methodological transition recorded by Greene and Breisch (2002). Older L. rufescens records for the area include specimens collected in 1925, 1933, and 1936 from a Washington, D.C. building that was not one of our collection sites (USNM collection) and the 1941 specimen from a nearby location in Maryland (Muma 1944).

The second question is whether the occurrence of L. rufescens throughout the Washington, D.C. area has resulted mainly from multiple introductions from foreign locations, active dispersal of the spiders through the subterranean infrastructure of the city, or passive dispersal as concealed hitchhikers in locally transported material. We favor the last explanation due to the high turnover rate ("churn") of personnel and associated boxed files, furniture, and equipment in the area’s government office buildings. (Waldron et al. 1975 observed...
Los Angeles County *L. laeta* specimens in cartons of merchandise and church rummage sale items.) Although our captures of isolated specimens that have wandered away from population centers (Figs. 1 and 2) indicate some degree of active dispersal is taking place that might well affect contiguous structures, *Loxosceles* spp. seem to display remarkably limited vagility in the absence of human assistance (Newlands 1981; Vetter 2005, 2008).

One consequence of *L. rufescens*’ troglophilic behavior in Washington, D.C. is a relatively limited suite of coexisting prey species that are sufficiently abundant to sustain dense spider populations. *P. americana* occurred in all 12 of the basement and first floor collection sites, with zones of greatest concentration closely overlapping those of the spiders. One of the world’s most widespread species, this cockroach has been recorded in virtually all of the mainland and island locations where *L. rufescens* has been found, including the caves of Kauai (USFWS 2006). Perhaps coincidentally, the smaller brown banded cockroach, *S. longipalpa*, was abundant at both of our sites where individual spiders were collected above the first floor (Fig. 1), as well as in the original Bldg. 1 rooms.

The occurrence (or evidence) of *Reticulitermes* sp. at five *L. rufescens* collection sites is noteworthy, not only because the spiders readily fed on the workers in the laboratory (Fig. 8), but because two of us (A.G. and N.L.B.) have observed *Loxosceles* adults (probably *L. arizonica* Gertsch and Mulaik) preying on termites (probably *Heterotermes aureus* (Snyder)) in a Tucson, AZ storage cubicule. The web of one female spider beneath a termite-occupied piece of wooden furniture contained numerous discarded worker bodies.

A third potential source of reliably encountered food for *L. rufescens* in Washington D.C. is the firebrat, *Thermobia domestica* (Packard). This insect has been recorded as prey for *L. rufescens* in Pennsylvania (Luke and Snetsinger 1971) and Levi and Spielman (1964) speculated that a firebrat infestation in the museum basement at Harvard University might have been brought under control by *L. laeta*. Although individual firebrats were only occasionally noticed in our basement and first floor collection sites, they occur in very high numbers at certain locations within the city’s steam tunnel systems (A.G., unpublished data), which might therefore coincide with some *L. rufescens* population loci.

**Public Health Implications and Pest Management.** Spiders in the genus *Loxosceles* are well known for possessing venom that can cause severe skin necrosis in some individuals and in rare cases even life-threatening systemic effects, although typical symptoms are relatively minor (Putrell 1992, Anderson 1998, Sandidge and Hopwood 2005, Vetter and Isbister 2008). The statement that “rufescens is reputed to have a far less dangerous venom than that of *laeta, reclusa*, and some other species” (Gertsch and Ennik 1983, p. 349) has been widely repeated throughout the literature, despite several lines of evidence suggesting this assumption is erroneous. Laboratory studies, both in vitro and with controlled bites or spider body extract injections in mice or rabbits, have demonstrated that enzymatic activity and resulting hemorrhagic/necrotizing ability of *L. rufescens* venom are comparable to that of other *Loxosceles* spp. (Shulov et al. 1960, Smith and Micks 1968, Young and Pincus 2001, Binford and Wells 2003). Clinical reports of *L. rufescens* bites corresponding to those reported for other *Loxosceles* spp. and confirmed with either a collected specimen (Efrati 1969, White et al. 1995, Stefanidou et al. 2006) or ELISA (Aldeniz et al. 2007) have been documented in Israel, Australia, Greece, and Turkey. A unique account of multiple *L. rufescens* envenomations involved personnel in an Israeli citrus grove who were bitten while crawling on densely infested leaf litter under trees (Borkan et al. 1995).

Reflecting decades of accumulated data, Vetter’s (2005) comment that “all *Loxosceles* spiders should be considered potentially capable of producing dermonecrosis to some extent” expresses a longstanding consensus among spider venom specialists (Gorham 1968, Barbaro et al. 1996, Gomez et al. 2001, Young and Pincus 2001, Binford and Wells 2003). Nevertheless, one of the more consistent and dismaying aspects of the pathology known as “necrotic arachnidism” or “loxoscelism” is the substantial number of diagnoses by medical professionals that are totally unsupported by confirmatory data. In the United States, where *L. reclusa* has been regarded as by far the most likely source of structural *Loxosceles* envenomation, the principal reasons for skepticism in the absence of a victim-collected, expert-determined specimen are 1) the high incidence of reported bites outside the relatively limited native range of *L. reclusa*, which, contrary to a prevailing misconception, only rarely occurs in states where it is not endemic, 2) the secretive and nonaggressive behavior of this species, and 3) the numerous other possible causes of similar appearing necrotic skin lesions (Anderson 1998, Vetter and Barger 2002, Vetter et al. 2003, Vetter 2005, Swanson and Vetter 2005, Vetter and Swanson 2007, Vetter and Isbister 2008).

We are aware that our observations of *L. rufescens* in Washington, D.C. may dilute the logical strength of the first argument, particularly for lay audiences. Broader recognition of a widespread *Loxosceles* species that can colonize structural locations is likely to complicate the efforts of entomological and arachnological professionals in countering unreasonable perceptions of risk. We strongly emphasize that the remoteness of this spider’s typical habitat combined with their extreme shyness makes human contact with *L. rufescens* exceedingly unlikely in most circumstances. None of us have been informed of any claimed necrotizing bites by an occupant of any of the buildings in which we conduct pest management activities. Moreover, we have never encountered any personnel who work in or close to the areas of greatest *L. rufescens* abundance who had even been aware that the spiders were present.

Naturally, there are rare circumstances in which risk of envenomation would be elevated. For example, a plumber fixing the sewage pipe leaks in the Bldg. 9 crawl space prior to spider control efforts would essentially be the structural counterpart of workers in the...
infested citrus grove described by Borkan et al. (1995). For this reason, our policy as either pest managers or consultants is that all confirmed and accessible population centers of *L. rufescens* should be the focus of ongoing mitigation efforts.

*Loxosceles* spp. are among the most difficult structural pests to control on a sustainable basis: they can enter a building through a multitude of narrow crevices, build up extremely dense but cryptic populations that harbor in concealed and well-protected microhabitats, survive for extraordinarily long periods of time indoors with limited or no food and water; and at least one species (*L. reclusa*) can scavenge on insects that have been dead for as long as one month (Hite et al. 1966, Horner and Stewart 1967, Elzinga 1977, Eskafi et al. 1977, Lowie 1980, Sandidge 2003). Although extensive deployment of glue traps, sealing of access points, and minimization of clutter have been shown to reduce their numbers, there is no evidence that these measures alone can typically achieve what most clients would consider to be an adequate level of suppression (Hedges and Lacey 1995, Merchant 2001, Sandidge and Hopwood 2005, Holper 2007, Townsend and Potter 2007). The most critical factor for managers of public buildings in the Washington, D.C. area is that the small number of *L. rufescens* individuals invading occupied space represent continuing and inevitable "leakage" from largely inaccessible population loci that cannot be completely sealed off from the remainder of the structure. Greene and Breisch (2002) noted that situations "where externally breeding pest species are continually generated from an immutable, decaying infrastructure, create 'pesticide sinks' in structural IPM programs that may persist until cost-effective alternate control technologies become available." Although there have been investigations of the biological control potential of geckos (Ramires and Fraguas 2004) and other spider species (Sandidge 2004), as well as preferred components of artificial refugia that might be used to enhance the attractiveness of traps (Vetter and Rust 2008), the current reality is that no nonchemical methodologies currently match the effectiveness of pesticides for recluse spider management.

Since direct contact at the time of application by either a sprayed or aerosolized formulation is unlikely to affect the majority of a target population sheltered deep in walls, foundations, and other protected hollow spaces, the selected product(s) should ideally have a high residual effect. Limited laboratory test data and anecdotal accounts from commercial treatments of residential *L. reclusa* infestations, as well as our own experiences in Bldgs. 1, 2, 5, and 9, suggest that liquids, aerosols, and dusts containing pyrethroids (i.e. the dominant class of insecticides currently available for indoor use), as well as silica gel dusts, provide locally effective but temporary control until populations gradually reestablish by immigration from surrounding harborage (Hedges and Lacey 1995, Merchant 2001, Holper 2007, Townsend and
We currently assume that—as with their Periplaneta and Reticulitermes prey—permanent eradication of L. rufescens is infeasible in most of the locations where we have found them and that monitoring of known habitats must continue indefinitely.

Distinguishing L. rufescens from L. reclusa

It is virtually impossible to tell specimens of L. reclusa and L. rufescens apart by casual observation—they are essentially the same size, shape, and color. As seen in Figs. 9-12, some sclerotized parts of L. reclusa adults tend to be more deeply pigmented than in L. rufescens, but variation among individuals renders this character unreliable. (Gross dissimilarities in hair and setae between the paired specimens in the figures only reflect differences in abrasion.) Other than the anterior carapace margins, the following descriptions of diagnostic features are annotations of Gertsch and Ennik’s (1983) discussions of the characters commonly used to distinguish between the two species of Loxosceles most likely to be found in a structural habitat throughout the U.S. and Canada. They are intended only as a point of departure for interested entomologists and pest managers. Since all other native species of the genus (as well as non-native synanthropic species such as L. laeta) may also potentially be encountered in a building, examination by an experienced arachnologist is essential to confirm the identity of any specimen.

Eyes. The eyes of adult L. reclusa are proportionally somewhat larger than those of L. rufescens, are arranged in a less recurved row (termed the “anterior row” by Gertsch and Ennik (1983)), and the three dyads are closer together (Fig. 9). Gertsch and Ennik (1983) defined these differences with more precise measurements for both species, but we feel that the eyes by themselves are of limited use for nonspecialists; the disparity in their size and arrangement are best appreciated when known specimens of both species are available.

Carapace. The anterior carapace margins of L. reclusa, from the clypeus to the rear eye dyads, are approximately parallel (Fig. 9a); those of L. rufescens diverge posteriorly at about a 45° angle (Fig. 9b). This previously unpublished character is constant with adult specimens examined by us during the course of this study, but has not been vetted over the years by multiple arachnologists as have the other diagnostic features discussed here.

Male Palpus. The adult male palpus is quite distinct between the two species. In L. reclusa, the tibia swells like a vase from a relatively narrow, almost stalk-like base, and the embolus is much longer than the width of the oval bulb (Fig. 10a). Viewed from above, the tarsus is broader than long and noticeably asymmetrical, with a prominent
lobe on its interior side (Fig. 11a). In L. rufescens, the Tibia does not have such a prolonged, narrow base and the embolus is only about as long as the width of the relatively globular bulb (Fig. 10b). Viewed from above, the tarsus is about as long as broad and not laterally developed (Fig. 11b).

**Spermathecae.** Although Gertsch and Ennik (1983) used the term “epigynum” as a synonym for female spider genitalia, modern convention restricts it to the external sclerotized structures associated with the genital opening, which are not present in haplogyne families such as the Sicariidae (Cushing 2005). The primary character used to distinguish adult *Loxosceles* females is the paired spermathecae (≡ “seminal receptacles” of Gertsch and Ennik 1983), which are internal and thus not as conveniently observed as the male palpi. Examination entails removing sufficient surrounding tissue to expose the structures, either by cutting through the overlying integument and folding it back (Cushing 2005) or by simply eviscerating the abdomen from the dorsal side. As with the males, the female genitalia of the two species are very different. In *L. reclusa*, the spermathecae are moderately separated at the midline and characterized by a single, narrow, finger-like lobe and often additional smaller and more rounded lobes toward the outside (Fig. 12a). Due in part to its pronounced sclerotization, this feature is often partially visible through the ventral abdominal wall of undissected specimens. In *L. rufescens*, the spermathecae are close together at the midline and characterized by a single lobe that is large and rounded (Fig. 12b). They are typically not visible through the abdominal wall unless the specimen has been eviscerated.

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