SHORT COMMUNICATION

The Prevalence of Brown Widow and Black Widow Spiders (Araneae: Theridiidae) in Urban Southern California

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ABSTRACT The brown widow spider, *Latrodectus geometricus* C. L. Koch, has become newly established in southern California during the first decade of the 21st century. Brown widows and egg sacs were collected within the urban Los Angeles Basin using timed searches. We also collected and compared the abundance and distribution of the native western black widow spider, *Latrodectus hesperus* Chamberlin & Ivie, to brown widows. Brown widows were very common around urban structures especially outside homes, in parks, under playground equipment, in plant nurseries and landscaping areas, greatly outnumbering native western black widows, and were very rare or nonexistent in garages, agricultural crops, and natural areas. Western black widows predominated in xeric habitats and were less prevalent around homes. Neither species was found in the living space of homes. In southern California, envenomation risk exists because brown widows are now common in urban areas and the spiders hide where people place their fingers and exert pressure to move objects (e.g., under the curled lip of potted plants, in the recessed handle of plastic trash bins). Nonetheless, brown widow spider bites are less toxic than those of native western black widow spiders and, hence, if they are displacing black widows, overall widow envenomation risk may actually be lower than before brown widow establishment.

KEY WORDS brown widow, *Latrodectus*, Arachnida, urban entomology, invasive species

In North America, the brown widow spider, *Latrodectus geometricus* C. L. Koch, was first documented in Florida in 1935 (Pearson 1936) where it had restricted distribution for decades in the peninsular portion of the state. In the first decade of the 21st century, it experienced a robust range expansion. By 2011, it became well established in the southeastern United States from Texas through South Carolina (Brown et al. 2008, Vincent et al. 2008). In southern California, it was first discovered in Torrance (Los Angeles County) in 2003 (Vincent et al. 2008) and has since spread throughout the Los Angeles and San Diego metropolitan areas through western Los Angeles County, east to western Riverside and San Bernardino counties and to the Mexican border. The brown widow was noticed not only by arachnologists but also by the general public because of their prolific numbers and distinctive spiked egg sacs that can often be found in conspicuous clumps of several to dozens at one web site.

When the brown widow was originally named in 1841, it was already known from Africa and South America (Garb et al. 2004), somewhat obscuring its likely place of origin. Garb et al. (2004) suggested Africa as the place of origin because of the wide distribution of brown widows on that continent and the presence of its closest sister species, *L. rhodesiensis* Mackay. The brown widow is pantropical in distribution, also being found in such environmentally diverse locations as Hawaii, the southeastern United States, Jamaica, Bermuda, Haiti, Cuba, Israel, Turkey, India, Australia, Papua New Guinea, Indonesia, the Phillipines, and Japan (Baerg 1954, Levi 1967, Levy 1998, Murphy and Murphy 2000, Garb et al. 2004, Bayram et al. 2008, Brown et al. 2008). However, as brown widows expanded throughout southern California, the question arose as to which of the many habitats they were newly colonizing; it would be surprising if the brown widow used these different environments equally. Although the brown widow is pantropical, there is little information reported about its microhabitat use.

We documented the presence of brown widow spiders in southern California by performing timed searches in various habitats such as urban property,

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agricultural lands, developed parks, and undeveloped natural areas. We also included the native western black widow spider, *Latrodectus hesperus* Chamberlin and Ivie, for comparison of abundance and habitat selection. Additionally, we relate this to envenomation risk for this newly colonizing spider.

Materials and Methods

This brown widow project was initially launched on the Center for Invasive Species Research Web site in the Entomology Department at the University of California-Riverside to alert the general public to the desire for brown widow spiders in southern California. From here, the project was subsequently promoted in three local newspapers, two television stations, a radio station, and the Orange County Master Gardener network such that most of the Los Angeles area was potentially aware of the need for spiders and egg sacs. Active collections by the authors were performed in Orange and western Riverside County at homes, elementary schools, parks, playgrounds, agricultural properties, zoos, horticultural properties or plant nurseries, and undeveloped areas. The choice of habitat was not random but instead was usually haphazardly chosen, influenced by the availability of properties (many generated through official contacts by one of us (J.N.K.)), and the proximity of these properties to the collectors. Home inspections were generated through publicity and the willingness of Master Gardeners and other home owners to volunteer their properties for inspection as well as requests made to family and friends of the authors. Because this funded brown widow project was simultaneously involved in looking for parasitoids and predators of egg sacs (Vetter et al. in press), one of the goals was to collect a large number of egg sacs for examination, hence, some of our choices were geared toward environments that we knew would be likely to be infested with brown widows. However, we attempted to canvas a variety of areas where interaction between humans and spiders would vary from low to high to assess the potential of envenomation risk. Because of the overwhelming populations of brown widows in many of the urban properties, for comparison, we actively chose additional habitats where black widows were historically very common before the establishment of the brown widow to determine if this numerical superiority of the invasive species extended to these other sites.

Spiders and/or their egg sacs were collected, placed in vials and given a unique number. The presence of a spider (and whether it was female, male, or immature), egg sacs (including the number of them), or both were noted at each site. We recorded the location of the spiders or egg sacs (i.e., under patio chair, in the recessed handle of a plastic garbage can) and the approximate height above the ground. At each collection property, the number of collectors (one to six) was recorded as well as the start and finish times. By doing so, we could calculate a rough estimate of the number of locations that harbored brown widow spiders per collector per collection hour to compare the different habitats.

We also collected western black widows and their egg sacs. The latter are readily distinguishable from brown widow sacs: black widow sacs are larger with a smooth outer surface. Because most (83%) of the data collections were performed during the day, this strongly biased our finding of brown widows. To detect the more secretive western black widows, we occasionally performed nocturnal collections but also did nocturnal censuses rather than collections where we just counted the spiders of each species. These censuses were also timed and the number of specimens for each widow species was counted. Immatures were collected to verify species if there was doubt of identity because immature western black widows can look very similar to brown widows of the same size (Vincent et al. 2008).

As we collected, we noted those locations where brown widow retreats would increase the likelihood of humans pressing their fingers or other body parts against the spider and possibly experience an envenomation. The goal was to provide this information to southern California homeowners to minimize the chance of a bite now that the brown widow have become ubiquitous.

Results

We collected data at 72 sites, which involved 96.8 h of collecting. Brown widow spiders were present at up to 32 locations per collector hour and are extremely common in urban southern California habitats (Table 1). The brown widow spider made its retreat or deposited egg sacs under picnic and patio tables (19.0%), under patio chairs (especially inexpensive plastic mold-injected chairs with many supporting pieces of ridges on the underside) (12.1%) (Fig. 1), under the horizontal support piece in wooden fences or under the overhanging capping of brick walls (with at least a >5 cm overhang) (13.9%), in the nooks on the undersides of plastic playground equipment (6.5%), under plastic garbage bins or in the downward-facing recessed handle (6.2%), and in the curled lips of potted plants (4%) (Table 2). They were never found inside houses and only rarely in garages or sheds (2%), typically only if the door was usually left open. They were also very common at horticultural and plant nursery facilities although at some of these places, they were more commonly found under the tables used for potting or maintaining the plants or under picnic tables used for social events rather than in the plants or on the containers themselves.

Brown widows were uncommon or absent in natural and agricultural areas (Table 1). We found them in curled or gathered leaves of citrus, avocado and apple trees, typically at urban homes, but not in citrus trees in an agricultural setting (Table 1). In contrast, black widows were abundant in agricultural settings (but never in managed tree crop vegetation) and less common around homes than brown widows. The urban areas where black widows dominated were in a

Table 1. The no. of *Latrodectus* spiders found in different habitats in southern California

	No. per collector per hour		Hours of collecting	Sample size
	Brown widow	Black widow		
Urban homes (day and night)	8.59 ± 6.78	0.42 ± 0.84	41.8	46
Urban homes (night only)[a]	7.86 ± 5.97	0.17 ± 0.41	6.3	6
Playgrounds	7.38 ± 4.00	0.33 ± 0.58	3.1	3
Plant nursery/horticultural	6.57 ± 4.05	0.60 ± 0.96	16.0	3
Zoos	3.35 ± 3.02	0.30 ± 0.43	8.4	2
Landscaped parks	9.21 ± 7.80	1.71 ± 1.21	7.1	5
Agriculture, citrus	0.00 ± 0.00	0.00 ± 0.00	5.4	2
Agriculture, avocados	1.25 ± 2.17	0.00 ± 0.00	2.8	3
Agriculture buildings (day collect)	2.12 ± 2.29	0.61 ± 0.15	9.6	2
Nocturnal censuses (counts but not collecting)				
Rural home zoned for horses	0.0	84.0	0.6	1
Apartment complex garages	0.0	90.0	0.2	1
Agricultural buildings	0.0	82.2	0.6	1
Undeveloped natural area	0.0 ± 0.0	2.6 ± 3.7	0.8	2
Industrial park	2.4	155.9	0.4	1

[a] Subset of the 46 urban homes that were inspected, presented here for comparison to the nocturnal surveys in the bottom portion of the table.

commercial business center with a stoneface exterior and in a series of apartment garages where they emerged from vertical gaps between the door and frame. In some instances such as under the curled lip of a potted plant, we found a mature female of both a brown and western black widow spider within 1 cm of each other.

Of the locations where they were collected, 78.3% of the brown widows were found within 1 m from the ground (Fig. 2); on rare occasion, they nested in the eaves of houses (Table 2). Many of these locations had high potential for envenomation such as in the recessed handle of a garbage can or under the lip of a potted plant. Black widows similarly exhibited a preference for locations close to the ground (Fig. 2).

When brown widows were present on a property, they usually greatly outnumbered our finds of western black widows (Table 1). At homes, we only collected 0.42 western black widows per collector hour; this rate was twenty times lower than for brown widows. How-

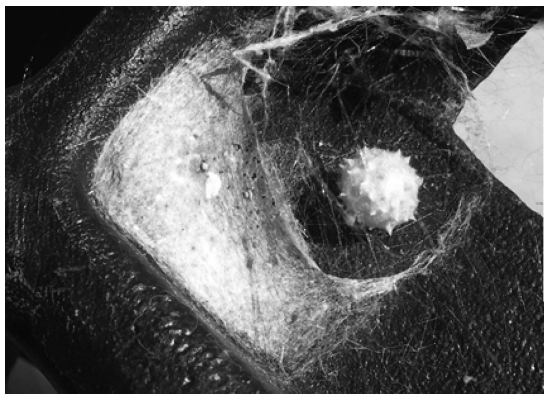

Fig. 1. Brown widow spider silk retreat and egg sac in the corner of the underside of a plastic chair. There is no inherent retreat; the spider created its own retreat out of silk.

Table 2. The microhabitat choices of *L. geometricus* in southern California ($N = 504$)

	Frequency
Outdoor furniture and patio items	
Table	96
Chair	61
Barbecue	6
Gazebo	3
Structural building	
Wooden fence and horizontal supports	38
Brick wall and overhangs	32
Bench	20
Eave	14
Chain link or wrought iron fence	10
Stairs, ramps	8
Shed	7
Window	6
Garage door	3
Shelf	2
Rock	2
Botanical and garden	
Lip of potted plant	20
Potted plant	15
Inside small plant or bush	10
Apple tree	4
Avocado tree	2
Composter	2
Green house	1
Recreational equipment	
Park playground equipment	33
Diving board	6
Bike, motorcycle	6
Household playground equipment	3
Trampoline	2
Boat	2
Water slide	2
Household accessories	
Trash can	31
Electrical box, socket	15
Water faucet	4
Hose reel	3
Water fountain	2
Mailbox	1
Other	29

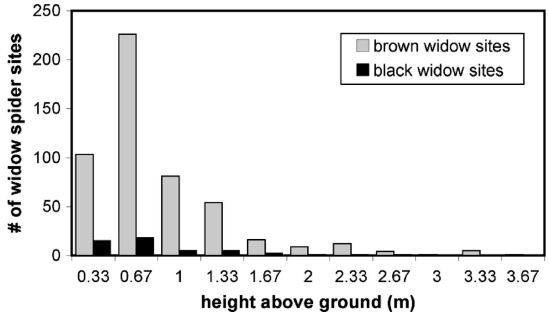

Fig. 2. The height above ground of locations where evidence of brown widow ($N = 512$) and black widow spiders ($N = 48$) or their egg sacs was found during collections. A location could have contained a spider, egg sacs, or both. Data were sorted into bins such that the number on the x-axis represents the upper limit of the estimated height (i.e., 1 m represents all data points from 0.68 to 1 m).

ever, nocturnal surveys demonstrated that black widows are still present in large numbers (at the University of California Agricultural Experiment Station and at homes with xeric landscaping), with brown widows rarely being found in these habitats (Table 1).

Discussion

In southern California, brown widows are found almost exclusively around urban structures such as outside homes, in plant nurseries, and other places where humans provide structures where spiders hide during the day. They are outdoor spiders, often making dense silk retreats under very exposed areas with an overhang. In comparison, although black widows share similar habitats, the black widow was less exposed, usually making its retreat in a protected hole in a wall, under debris as well as in garages or sheds, typically near vents or the door where, presumably, insect traffic was greater. Neither species was found in homes, corroborating an observation made for brown widows in Brazil (Cardoso et al. 2003).

Brown widows are extremely rare in agricultural settings; they were not found on old, unused farm machinery and were only found on very rare occasion in citrus, avocado, and apple trees. An Orange County entomologist noted that brown widows were found occasionally in citrus trees (N. Nisson, personal communication). At the University of California Riverside Agricultural Experiment Station, only western black widows were observed during a nocturnal survey; the only brown widow from this property was found in a large irrigation timing box by one of the maintenance staff during the day. Homes ($N = 4$) that were within 1 km of this agricultural property were almost exclusively infested with brown widows. In Jamaica, Baerg (1954) reports the brown widow being a house spider, but from his description, it corroborates what we found, that is, peridomestic rather than inside the home. He mentions brown widows being common in a partially enclosed verandah under tables and chairs, under ledges on the outside of houses especially the north side, and at automobile service stations. It would be interesting for a complementary study to be performed to determine the microhabitats used by the brown widow spider in the more humid southeastern United States.

The lack of brown widows in natural, xeric habitat in Mediterranean climate could be caused by insufficient solid, horizontal overhanging protection under which they can seek shelter whereas western black widows choose abandoned rodent burrows or the crevices of rock formations. (Although in Arizona, Johnson et al. (2012) noted that western black widows were 47 times more common in urban environments than native Sonoran desert habitat.) Around human structures, brown widows take up residence under objects with minimal but solid cover. For example, the slight 5 cm overhang of a horizontal fence support or stone cap of a wall is sufficient protection allowing the brown widow to make a thick silk retreat; this is too exposed for a western black widow. This habitat difference was emphasized in the urban apartment garage habitat where the vertical gap next to the door was sufficient for black widow web site location but lacking a horizontal retreat, seemed to preclude brown widows found elsewhere on the property. The lack of light emanating from above may be critical for an acceptable brown widow retreat. Anecdotally, we noticed that although brown widows were often found in the recessed handles of plastic trash bins, occupancy was dependent on the design: if the top of the depression was solid, brown widows were more likely to be found than if the design incorporated holes in the top that allowed light and possibly airflow through the depression. Likewise, brown widows were common under tables with solid tops and patio chairs with solid seat bottoms but were extremely rare under patio tables with metal mesh tops and patio chairs with fabric mesh seats. Western black widows still flourish in other habitats such as agricultural and xeric landscapes.

In Hawaii, Bianchi (1945) reports that military barracks housed an extremely dense population of the southern black widow, *L. mactans* (F.), in 1939 that was almost completely replaced by the brown widow when he visited 5 yr later. He attributed this takeover to habitat displacement by the brown widow, as opposed to the conflicting contributing factor of a release of the egg parasitoid wasp *Baeus* (=*californicus*) *latrodecti* Dozier (Platygastridae), which readily attacks egg sacs of *L. mactans* but not brown widows (Pemberton and Rosa 1940). Baerg (1954) mentions a similar displacement of *L. mactans* by the brown widow in Jamaica but only in urban areas; brown widows were nonexistent on other parts of the island whereas *L. mactans* was present elsewhere but in low numbers. Because we have no preinvasion census numbers, we cannot properly assess whether the brown widow has had a competitive effect on the western black widow population in southern California, however, anecdotally, arachnologists, naturalists, and home owners in the Los Angeles area have stated that black widow

populations have decreased with the coincident appearance of the brown widow.

Despite the fact that most brown widow envenomations are minor events, the general public assumed that these spiders are significantly toxic. The work of Müller (1993), which reports 15 verified brown widow bites in Africa, shows that they pale in comparison to typical *Latrodectus* bites. Reports do exist of more substantial brown widow envenomations in Mississippi (Goddard et al. 2008), Brazil (Cardoso et al. 2003), and Venezuela (Kiriakos et al. 2008) but, as is typical in the medical literature, single case histories get published because of their extreme symptom expression and, hence, skew literature representation toward the rare and dynamic end of the spectrum. Although brown widows are now abundant in southern California, bites are not common where in our collective experience, we are only aware of one verified brown widow bite, which had minor symptoms. Hence, the probability of envenomation in southern California by a *Latrodectus* spider might increase with the further urban encroachment of brown widows while paradoxically, simultaneously decreasing the risk of overall *Latrodectus* envenomation because of minor symptoms of a brown widow bite.

Homeowners would benefit to know about the hiding places of brown widows, displaying care when placing their hands in nooks and crannies. Even with the toxicological aspects aside, the dissemination of this knowledge should reduce psychological trauma by lessening anxiety and paranoia about spider bites. One final benefit is that it could also result in reduced pesticide use if homeowners are more wary about where to actually find the spiders and not perform broadcast, pesticide applications around homes.

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