FORUM

Arachnids Submitted as Suspected Brown Recluse Spiders (Araneae: Sicariidae): *Loxosceles* Spiders Are Virtually Restricted to Their Known Distributions but Are Perceived to Exist Throughout the United States

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ABSTRACT An Internet offer was made to identify any spider in the United States perceived to be a brown recluse spider, *Loxosceles reclusa* Gertsch & Mulaik (Sicariidae). In total, 1,773 arachnids from 49 states represented three orders (Araneae, Solifugae, and Opiliones) and the identifiable spiders (Araneae) consisted of 38 families, 88 genera, and 158 recognizable species. Participants from states at least half within the known brown recluse distribution submitted *Loxosceles* spiders 32–89% of the time, except Louisiana and Mississippi with no submissions. From 25 of 29 states completely or almost completely outside of the range of *Loxosceles* spiders, no recluse spiders were submitted. Only two discoveries of brown recluses and two of the worldwide tramp species *Loxosceles rufescens* (Dufour) were submitted from nonendemic *Loxosceles* areas. States on distribution margins of brown recluse or other native *Loxosceles* spiders were intermediate in their *Loxosceles* submissions. This study showed that 1) the general public perceives brown recluses to occur over wide-ranging areas of the United States; and 2) brown recluses are frequently submitted from endemic states and almost never from nonendemic states, and therefore are virtually limited to their known distributions. This study corroborates opinions that diagnosis of brown recluse spider bites is best restricted to areas historically supporting proven, widespread populations of *Loxosceles* spiders.

KEY WORDS *Loxosceles reclusa*, Arachnida, misidentifications, distribution

ALTHOUGH BROWN RECLUSE SPIDERS, *Loxosceles reclusa* Gertsch & Mulaik (Sicariidae), are historically limited to the central and south central United States, their reputation causes people to assume that they are routinely found throughout North America. This spider was first associated with necrotic skin lesions in the United States by Atkins et al. (1957). The distribution of populations of *L. reclusa* is well demarcated from southeastern Nebraska through the southernmost strip of Ohio and south into Texas to northern Georgia and western South Carolina (Gertsch and Ennik 1983; Vetter 2000; Swanson and Vetter 2005; unpublished data). There are 10 additional native *Loxosceles* species in the United States, five having significant distributions (Gertsch and Ennik 1983, Swanson and Vetter 2005). Two exotic species, *Loxosceles rufescens* (Dufour) and *Loxosceles laeta* (Nicolet), also are sporadically found within the United States. *L. rufescens*, originating from the Mediterranean region, is rare but scattered across the United States. *L. laeta*, originating from South America, is known to have tightly circumscribed populations in cities in urban Los Angeles Co., California; one house in Polk Co., Florida, and the basement of the Museum of Comparative Zoology at Harvard University, Cambridge, MA (Gertsch and Ennik 1983, Vetter et al. 2004). Although there are suspected variations in virulence among the species, all *Loxosceles* spiders should be considered potentially capable of producing dermonecrosis to some extent.

Since 1957, the infamy of the brown recluse and other *Loxosceles* species has spread such that diagnoses of brown recluse spider bites are commonly made throughout North America where recluse spiders are rare or have never been found (Russell and Gertsch 1983; Russell 1986; Vetter 2000; Vetter and Bush 2002a, b; Vetter et al. 2003, 2004; Bennett and Vetter 2004; Swanson and Vetter 2005). In addition to medical misdiagnoses, this misconception of brown recluse spider presence continues to be perpetuated by hyperbolic and unsubstantiated news media reports of alleged bites or alleged recluse sightings outside its endemic range and an anxious general public believing erroneous word-of-mouth. This misconception is further entrenched by the misidentification of common harmless spiders as brown recluses by nonarachnologists.

Many members of the general public and the medical community suggest that alleged brown recluse

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spider bite diagnoses are justified throughout North America because of the erroneous perceptions that 1) brown recluses are a common constituent of their local arachnid fauna and that 2) brown recluse spiders are frequently transported out of their native range and establish breeding populations (Vetter and Bush 2002a, Vetter 2003). If either of these suppositions was true, then brown recluse spiders would readily be captured because in supportive habitats, it is not uncommon to collect dozens to thousands in individual homes (Schenone et al. 1970, Gooch 1999, Vetter and Barger 2002, Sandidge 2004). Therefore, it is not difficult to document the presence of *Loxosceles* spiders where they exist.

This study was undertaken to demonstrate 1) that the brown recluse spider is perceived to exist throughout the United States, 2) to ascertain whether the brown recluse spider has spread beyond the known distribution from that presented in the taxonomic genus revision of Gertsch and Ennik (1983), and 3) whether the brown recluse spider should be considered medically significant in nonendemic areas.

Procedures for Arachnid Submissions

From 1992 to early 2000, ≈90 California arachnids submitted as possible brown recluses to the Department of Entomology, University of California-Riverside (UCR), were identified and recorded. In May 2000, an offer (the brown recluse challenge) was made on the UCR spider Web site (spiders.ucr.edu) to identify any spider from the United States that was perceived to be a brown recluse. This study was terminated in January 2005.

Criteria for inclusion in the study was that the participant needed to be unsure of identity or wanted verification that a spider was a brown recluse or related *Loxosceles* species. (Some participants were aware of the lack of brown recluse spiders in their area but knew that native species (*Loxosceles deserta* Gertsch, *Loxosceles arizonica* Gertsch & Mulaik, *Loxosceles apachea* Gertsch & Ennik, southwestern United States) or a non-native species [*L. laeta*, Los Angeles, CA; Polk Co., Florida] could be found). If the participant was confident of the identification and originated from well within the known distribution of *L. reclusa* spiders, these data points were omitted (about a dozen submissions were discarded by this criterion). This allowed comparisons to be made between submissions from endemic and nonendemic recluse states (i.e., knowledgeable participants from within endemic areas would increase the percentage of recluse identification accuracy, whereas, inherently, this group would not exist in nonendemic *L. reclusa* areas). However, people from outside or from the margins of endemic *Loxosceles* areas who were sure that they had correctly identified their spiders as brown recluses were encouraged to submit their specimens. Although this is not a perfect separation of groups, it was the best that could be devised to allow comparisons between endemic and nonendemic *Loxosceles* areas. Participants were given instructions for mailing specimens to UCR to minimize damage as well as how to follow postal regulations (i.e., do not mail flammable liquids). Participants were encouraged to send high-quality digital images instead of mailing specimens. If the specimen was not identifiable from the image, the participant was requested to mail the specimen to UCR.

Data recorded included city/town, county, and state where the specimen was collected; if available, date of collection was recorded, otherwise, the date of package received was used. The few nonspider arachnids were identified to order. Spiders were identified to species in most cases for mature specimens. However, occasional specimens were only identifiable to genus or family level (due to making an identification from an electronic image, receiving immature specimens, destructive collection techniques, or pulverization from nonprotective packaging during transit). Wolf spiders (Lycosidae) were most often identified to family or genus because their taxonomy is incomplete and complicated due to a multitude of species throughout the United States and slight variation of the genitalic figures used to differentiate genera and species. The common wolf spider genus *Hogna* (formerly *Lycosa*, which is now considered a solely Old World genus) is used here, although not all North American *Lycosa* spp. have officially been transferred. *Cheiracanthium* has recently been transferred back into the Clubionidae along with the other members of the Eutichurinae, but this transfer is not accepted by all arachnologists (Raven and Stumkat 2003); therefore, it is listed in the family Miturgidae. Other specimens were identified as best possible given the incomplete taxonomic status of various spider taxa (e.g., Tengellidae) and quality of transmitted electronic images. Although most of the difficult-to-identify spiders were identifiable to family, there were a few that could only be determined as non-*Loxosceles* spiders. Occasionally, determination of *Loxosceles* specimens could not be verified to species (the specimen was immature or submitted as an electronic image); these specimens (virtually all from *L. reclusa* areas) were assigned to species via geography. However, all *Loxosceles* specimens presented from nonendemic areas were mature such that species identification in these special cases was assured. Submissions from California constituted 32.8% of the total; therefore, data presented in the tables is listed as California and United States minus California.

Most specimens were procured through the brown recluse challenge; however, additional specimens were forwarded from arachnologists, public health personnel, county entomologists, county extension agents, or pest control personnel who were aware of the study and who receive suspect recluse spiders for identification. In addition, several media promotions of the brown recluse challenge or unsubstantiated bite reports resulted in heavy, localized submissions from Peoria, IL; Suffolk Co., New York; Lubbock, TX; and Okaloosa Co., Florida.

The limits of *Loxosceles* spp. distribution used in this study are based on the distribution maps in Gertsch

Table 1. Arachnid submissions recorded by state grouped with consideration of the degree of area that is historically known to support native U.S. *Loxosceles* spider populations

State	Total no. of submissions	Total no. of *Loxosceles*	% *Loxosceles*	*Loxosceles* spp.
States with at least half of its area within endemic *Loxosceles* area				
Texas	142	85	59.9	*reclusa* (82), *blanda* (3)
Illinois	91	27	29.7	*reclusa*
Missouri	65	58	89.2	*reclusa*
Kansas	56	43	76.8	*reclusa*
Oklahoma	43	32	74.4	*reclusa*
Kentucky	35	22	62.9	*reclusa*
Tennessee	29	16	55.2	*reclusa*
Indiana	27	10	37.0	*reclusa*
Alabama	25	8	32.0	*reclusa*
Louisiana	18	0	0	
Arkansas	15	10	66.7	*reclusa*
Mississippi	4	0	0	
States within less than half of its area within *Loxosceles* distribution				
California	581	19	3.3	*deserta* (17), *laeta* (1), *reclusa* (1)
Arizona	33	8	24.2	*deserta*
Ohio	33	6	18.2	*reclusa* (all from same house)
Georgia	32	1	3.1	*reclusa*
Nevada	31	9	29.0	*deserta*
North Carolina	30	0	0	
Utah	26	0	0	
South Carolina	17	0	0	
New Mexico	15	2	13.3	*apachea*
Nebraska	13	3	23.1	*reclusa*
Iowa	7	2	28.6	*reclusa*
States outside the distribution of *Loxosceles* spiders				
Florida	129	0	0	
New York	41	0	0	
Washington	40	0	0	
Oregon	32	0	0	
Virginia	24	3	12.5	*reclusa* (all from one shed)
Colorado	19	1	5.3	*rufescens*
Pennsylvania	19	2	10.5	*rufescens* (from same building)
Wisconsin	16	0	0	
New Jersey	14	0	0	
Michigan	12	0	0	
Alaska	12	0	0	
Maryland	10	0	0	
Massachusetts	8	0	0	
Minnesota	6	0	0	
Connecticut	5	0	0	
Rhode Island, West Virginia	3 each	0	0	
Idaho, Montana, Wyoming	2 each	0	0	
Hawaii, Maine, North Dakota, New Hampshire, South Dakota, Vermont	1 each	0	0	

and Ennik (1983) as well as over a decade of personal research ferreting out this information via many regional publications, unpublished maps, and correspondences with arachnologists, public health officials, Department of Health personnel, pest control operators, and others who have local knowledge of *Loxosceles* distribution in their areas. The culmination of this information is presented in a recently published map in Swanson and Vetter (2005). Additional information may expand or shrink the current known distribution.

Arachnid Submission Findings

Overall. In total, 1,773 arachnids were submitted from 49 states (only Delaware recorded no submissions) (Table 1). There were 1,757 spiders, 10 windscorpions (order Solifugae), five harvestmen (order Opiliones), and one spider exuvia (Table 2). Among the spiders, there were 38 families, 88 identifiable genera, and 158 identifiable species. Spiders ranged from the tiny *Oecobius* (3-mm body length) up to large specimens of *Heteropoda venatoria* (L.), *Hogna carolinensis* Walckenaer, *Dolomedes tenebrosus* Hentz, and the mygalomorph *Calisoga* sp. (20–35-mm body length), whereas mature *Loxosceles* spiders range from 7 to 12 mm in body length.

***Loxosceles* Spiders.** A total of 324 brown recluse spiders, *L. reclusa* (Fig. 1) were submitted from 15 states (Fig. 2). All but four specimens were submitted from states historically considered to be within the known distribution of the spider (Table 1). One specimen was presented from a northern California home where the occupants had relocated from Missouri; no

Table 2. Specimens submitted as possible brown recluses categorized by order and for spiders, further categorized by infraorder and family

	United States minus California	California	Total
Solifugae	1	9	10
Opiliones	1	4	5
Araneae			
Mygalomorphae			
Nemisiidae	1	9	10
Antrodiaetidae	6	0	6
Ctenizidae	0	6	6
Cyrtaucheniidae	2	0	2
Araneomorphae			
Theridiidae	65	100	165
Agelenidae	111	39	150
Lycosidae	125	25	150
Filistatidae	103	19	122
Araneidae	63	53	116
Pholcidae	48	25	73
Gnaphosidae	23	46	69
Dysderidae	33	33	66
Tengellidae	0	61	61
Sparassidae	35	21	56
Miturgidae	23	24	47
Pisauridae	40	0	40
Corinnidae	21	14	35
Amphinectidae	13	19	32
Anyphaenidae	20	8	28
Amaurobiidae	21	5	26
Thomisidae	21	2	23
Scytodidae	20	0	20
Philodromidae	16	3	19
Zoropsidae	0	18	18
Dictynidae	7	0	7
Salticidae	4	3	7
Mimetidae	3	3	6
Oecobiidae	3	2	5
Linyphiidae	1	2	3
Clubionidae	3	0	0
Tetragnathidae	0	3	3
Cybaeidae	0	2	2
Selenopidae	2	0	2
Desidae	0	1	1
Oxyopidae	0	1	1
Plectreuridae	0	1	1
Segestriidae	1	0	1
Unidentifiable beyond order	12	1	13
Exuvia	1	0	1

additional brown recluses were found in the home in follow-up correspondence. Three specimens, including a mature male from a shed in coastal Virginia, were presented with the submitter stating that there were dozens more; requests to uncover additional specimens in nearby homes resulted in no additional recluse spiders. People in states where *Loxosceles* distribution (all *L. reclusa*) covered more than half of the state submitted *Loxosceles* spiders between 30 and 89% of the time, except for no *Loxosceles* submissions from Mississippi (only four specimens submitted) and Louisiana (where submissions were almost all from coastal regions; see *Discussion*) (Table 1). People in states where the *Loxosceles* distribution (*L. reclusa* plus other *Loxosceles* spp.) covered less than half of the state submitted recluse spiders between 0 and 29% of the time (Table 1). Of the 26 states considered outside historic *Loxosceles* distributions of any species, no *Loxosceles* spiders were submitted from 23 states, *L. rufescens* spiders were submitted from two states (Colorado and Pennsylvania) with the one previously mentioned find of *L. reclusa* in Virginia (Table 1).

Additional native *Loxosceles* spiders (34 *L. deserta*, three *Loxosceles blanda* Gertsch & Ennik, and two *L. apachea*) were submitted from five states (California, Nevada, Arizona, New Mexico, and Texas), all submissions emanating from locations where the spiders are known to occur. One specimen of the South American *L. laeta* was submitted from San Gabriel, CA (a city where the initial infestation was known in 1967; (Waldron 1969)).

Species Other than *Loxosceles*. The remaining 1,406 specimens submitted as brown recluse spiders belonged to three arachnid orders (Araneae, Solifugae, and Opiliones). The five most common spider families submitted, with >100 specimens each, were comb-footed spiders (Theridiidae), funnel weavers (Agelenidae), wolf spiders (Lycosidae), crevice weavers (Filistatidae), and orb weavers (Araneidae) (Table 2). Nationwide, *Kukulcania* (Fig. 3) was the most common genus of non-*Loxosceles* spider submitted as a brown recluse (Table 3), with *Kukulcania hibernalis*

Fig. 1. Brown recluse spider, *L. reclusa* (Sicariidae).

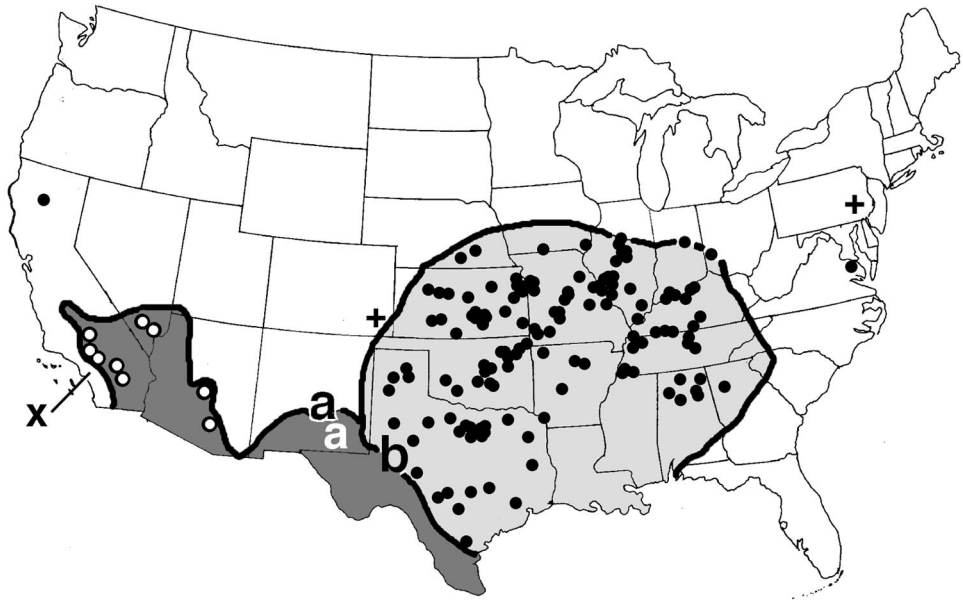

Fig. 2. Distribution of *Loxosceles* spiders submitted in this study. ●, *L. reclusa*; ○, *L. deserta*; a, *L. apachea*; b, *L. blanda*; x, *L. laeta*; +, *L. rufescens*. The light gray area shows the known widespread distribution of the brown recluse in the United States based on Gertsch and Ennik (1983) as well as 12 yr of personal research. The dark gray area shows the known widespread distribution for five native American *Loxosceles* species in the southwestern United States.

(Hentz) being the most commonly submitted non-*Loxosceles* species (Table 4). The comb-footed spider genus *Steatoda* was the second most common genus nationwide (Table 3), mostly due to the large number of *Steatoda grossa* (C. L. Koch) spiders (Fig. 4) submitted from California (Table 4). *Dysdera* was the third most common genus submitted nationwide (Table 3), with its only U.S. species, *Dysdera crocata* C. L. Koch (Fig. 5), being the second most common species submitted from both California and nationwide. A partial list of the remaining spiders is found in Tables 3 and 4; a complete list is available upon request.

Verified Bites, Persons with Bite Diagnoses, and Misidentification by Authority Figures. Several submissions came from people with verified bites (i.e., the spider was caught in the act of biting and retained for identification). Four bites were caused by brown recluse spiders, all from endemic *L. reclusa* areas (Manhattan, KS; Oxford, AL; Sidney, AR; and Okmulgee, OK). Of three where information was provided, one bite led to a necrotic lesion, another had only mild facial swelling and erythema, and the third was cloaked by irritating homeopathic measures (repeatedly rubbing raw garlic on the lesion). Other submissions to ascertain whether a verified biting spider was possibly a brown recluse spider were *Myrmekiaphila* sp. (Cyrtaucheniidae); *Cheiracanthium mildei* L. Koch (Miturgidae); *Metaltella simoni* (Keyserling) (Amphinectidae); *Kukulcania* sp.; *Plectreurys tristis* Simon (Plectreuridae); *Titiotus* sp. (Tengellidae); *Trachelas pacificus* Chamberlin & Ivie (Corinnidae); and an im-

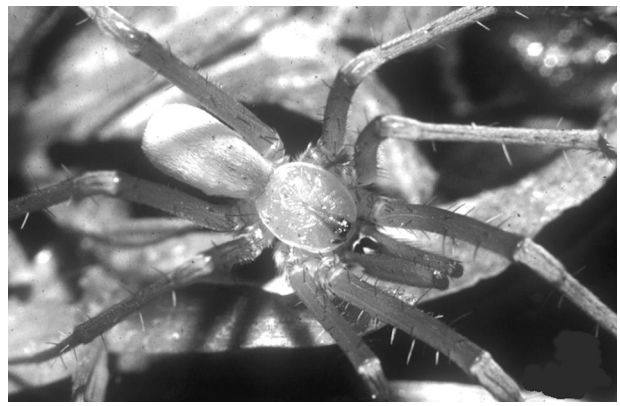

Fig. 3. Male *K. utahana* (Filistatidae).

Table 3. Number of the most common non-*Loxosceles* genera submitted as brown recluse spiders (minimum of 10 specimens nationwide)

Genus	Family	United States minus California	California	Total
Kukulcania	Filistatidae	103	19	122
Steatoda	Theridiidae	31	77	108
Dysdera	Dysderidae	33	33	66
Tegenaria	Agelenidae	60	2	62
Hogna	Lycosidae	48	3	51
Titiotus	Tengellidae	0	49	49
Agelenopsis	Agelenidae	35	10	45
Neoscona	Araneidae	16	20	36
Cheiracanthium	Miturgidae	10	23	33
Araneus	Araneidae	18	14	32
Metaltella	Amphinectidae	13	19	32
Pholcus	Pholcidae	27	5	32
Herpyllus	Gnaphosidae	16	15	31
Trachelas	Corinnidae	18	12	30
Olios	Sparassidae	7	20	27
Heteropoda	Sparassidae	26	0	26
Achaearanea	Theridiidae	23	2	25
Dolomedes	Pisauridae	23	0	23
Hololena	Agelenidae	0	22	22
Scytodes	Scytodidae	20	0	20
Zoropsis	Zoropsidae	0	18	18
Latrodectus	Theridiidae	0	16	16
Holocnemus	Pholcidae	0	15	15
Psilochorus	Pholcidae	10	4	14
Xysticus	Thomisidae	13	1	14
Callobius	Amaurobiidae	11	2	13
Rabidosa	Lycosidae	13	0	13
Schizocosa	Lycosidae	5	5	10

mature gnaphosid, probably either *Herpyllus* sp. or *Scotophaeus blackwalli* (Thorell). All resulted in minor injury.

Several dozen submissions were from people from nonendemic *Loxosceles* states where their physicians had diagnosed their lesions as brown recluse bites, although no spider was associated with the incident (accurate counts of these data were not recorded). Spiders were subsequently collected from their homes and submitted, none of which were *Loxosceles* spiders.

Authority figures misidentified harmless or mostly benign spiders as recluse spiders. Misidentifications were made by physicians where a patient with a verified bite or necrotic skin lesion presented a spider ($n = 4$), by physicians submitting randomly collected spiders thought to be recluse spiders ($n = 4$), and by medical personnel using spiders as teaching aids for recluse identification ($n = 4$). One verified bite by an immature California gnaphosid spider had minor but noteworthy neurological effects; the spider was identified by the physician as "some kind of brown recluse." A particular egregious misidentification episode was that of a large male *K. hibernalis* and a small *Psilochorus* spp. (Pholcidae) being used in a Texas medical school to educate medical students regarding brown recluse identification. Several additional authority figure misidentifications were made by pest control personnel [*K. hibernalis* in Alabama, windscorpions in California, and *Amaurobius ferox* (Walckenaer) in Ohio] and a veterinarian and three county health officials (*A. ferox* in Michigan).

Table 4. Number of the five most common non-*Loxosceles* species submitted as brown recluse spiders for California and the remainder of the United States

	Family	Total
United States minus California		
Kukulcania hibernalis (Hentz)	Filistatidae	103
Dysdera crocata C. L. Koch	Dysderidae	33
Pholcus phalangioides (Fuesslin)	Pholcidae	27
Heteropoda venatoria L.	Sparassidae	26
Achaearanea tepidariorum (C. L. Koch)	Theridiidae	23
California		
Steatoda grossa (C. L. Koch)	Theridiidae	66
Dysdera crocata C. L. Koch	Dysderidae	33
Cheiracanthium mildei L. Koch	Miturgidae	23
Scotophaeus blackwalli (Thorell)	Gnaphosidae	22
Metaltella simoni (Keyserling)	Amphinectidae	19

Discussion

The infamy of the brown recluse spider has spread so that it is perceived by the general public to possibly exist throughout North America as can be assessed by submissions from 49 states, including Alaska and Hawaii. In sharp contrast, *Loxosceles* spiders were submitted virtually exclusively from areas in the United States historically known to support populations of this medically important genus (Fig. 1). Unfortunately, many native and harmless spiders throughout the country were perceived to be brown recluses.

Endemic *Loxosceles* Areas. In endemic brown recluse areas of the United States, *L. reclusa* spiders are frequently submitted (Fig. 2; Table 1), are synanthropic spiders (i.e., populations increase in association with humans), and are an urban pest control issue. The high percentage of submissions from some states was no doubt due to better discrimination from having actual experience with the animal in question. No *Loxosceles* spiders were submitted from Mississippi and Louisiana, although both are considered within the range of the brown recluse. For Mississippi, this is due to low sample size ($n = 4$), and for Louisiana, 17 of the 18 specimens originated from within 50 km of the coast where anecdotally recluse populations diminish (see below).

Other native *Loxosceles* species (*L. deserta*, *L. blanda*, and *L. apachea*) were submitted from areas of the United States where they are known to exist. However, they were not submitted as often or in as great a quantity as the brown recluse spider, were not as synanthropic, and lived in southwestern deserts sparsely populated by humans. Native North American *Loxosceles* spiders living in the southwestern deserts seem to only inhabit homes surrounded by natural desert landscaping unaltered by human development. The one specimen of the South American *L. laeta* was not only submitted from a Los Angeles County city where it was found in 1967, but the collection locale was across the street from the San Gabriel Mission, listed as a collection locale for *L. laeta* in Gertsch and Ennik (1983).

***Loxosceles* Spiders in Nonendemic Areas.** Brown recluse spiders in nonendemic *Loxosceles* areas were

Fig. 4. Female *S. grossa* (Theridiidae).

found as a single specimen in the northern California home of a family that had moved from Missouri and the establishment of a population in a shed in coastal Virginia. Speculative comments often made by authors in the popular literature (and unfortunately in medical literature as well) are that it is *possible* that brown recluses can be transported anywhere in the United States (Lee et al. 1969, Wand 1972, Gutowicz et al. 1989, Futrell 1992, Sams et al. 2001), which then leads to the unsubstantiated presumption that these spiders are a reasonable source of dermal necrotic lesions nationwide. These authors never provide proof to show that brown recluse spiders are actually widely distributed. The existing evidence demonstrates the extreme rarity of finding *Loxosceles* spiders throughout nonendemic *Loxosceles* areas of North America (Gertsch and Ennik 1983; Vetter and Bush 2002a; Vetter et al. 2003, 2004; Bennett and Vetter 2004; this study); the frequent translocation theory is largely discounted. My attempts to uncover verifications of *L. reclusa* populations outside of endemic areas has produced <10 infestations for the entire country with almost every infestation restricted to one building (unpublished data).

In this study, one discovery consisted of two *L. rufescens* submitted from Pennsylvania and one specimen from Colorado (Table 1). Paradoxically, this rare, non-native recluse spider is more likely to be found outside endemic *Loxosceles* areas throughout the United States than is the native *L. reclusa* (Gertsch and Ennik 1983). Mature specimens are listed from 20 U.S. cities in Gertsch and Ennik (1983), and I have had specimens (often initially misidentified as *L. reclusa*) sent to me from arachnologists and knowledgeable pest control personnel from 15 locales, some being the same locales listed in Gertsch and Ennik (1983) and others being interceptions of single itinerants in cargo. Virtually all locales have been municipal, commercial, or university-related structures. Although this non-native species can be found in high numbers once established, typical of *Loxosceles* spp., the infestation is limited to one building or a few buildings that are interconnected by conduits. I am aware of no verified *L. rufescens* bite in North America nor of a specimen submitted from an alleged envenomation locale. Gertsch and Ennik (1983) mention that *L. rufescens* "is reputed to have a far less dangerous venom than that of *laeta*, *reclusa* and some other species."

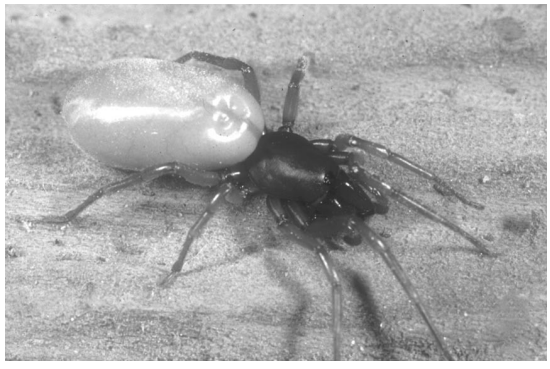

Fig. 5. *D. crocata* (Dysderidae).

Other Submissions from Nonendemic *Loxosceles* Areas. Throughout the United States, a variety of spiders were submitted as potential brown recluse spiders. The most common non-*Loxosceles* spider was *Kukulcania* spp. which is understandable because both male *Kukulcania* (Fig. 3) and *Loxosceles* spiders (Fig. 1) have tan coloration, similar abdomen-to-cephalothorax lengths and widths as well as legs in similar proportion to the body and length-to-width ratios. However, as mollifying as this may be, also submitted were many female and immature *Kukulcania* specimens, which are black or dark brown throughout, looking nothing like *Loxosceles* spiders. The high frequency of *Kukulcania* is intriguing, considering that it only exists in the southernmost strip of the United States from California to Florida. *S. grossa* (Fig. 4) is colloquially known as the false black widow where females are uniformly chocolate brown and look similar to black widow spiders (except lacking a red hourglass), whereas males have pale orange legs and tan spots on the brown abdomen. Neither sex of

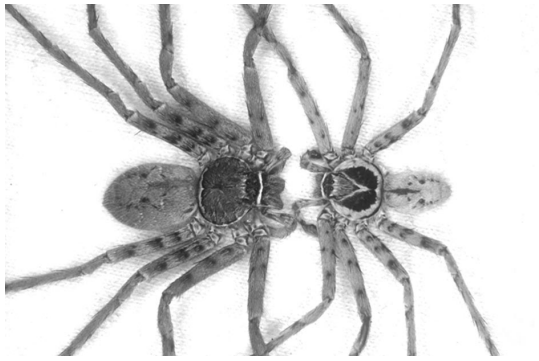

Fig. 6. *H. venatoria* (Sparassidae), female on left, male on right, spiders were frozen and posed for comparison.

S. grossa looks much like a *Loxosceles* spider yet both sexes were heavily submitted. Another common submission, *D. crocata* (Fig. 5), colloquially known as the woodlouse spider, has no dark markings on its body. It is puzzling that this spider is mistaken so frequently as a brown recluse. Several submitters mentioned that because it has large fangs, it was perceived to be dangerous (i.e., a brown recluse).

Two intriguing species submitted in high numbers despite very limited distribution were *H. venatoria* (Sparassidae) (body length 12–20 mm; Fig. 6) and *Zoropsis spinimana* (Dufour) (Zoropsidae) (body length 11–16 mm). *H. venatoria* was the fourth most common species submitted nationwide, although it is mostly restricted to Florida, with 25 of 26 submissions emanating from that state. The cephalothoracic pattern on the male (Fig. 6, right) was occasionally mistaken for a violin but many patternless females (Fig. 6, left) also were submitted because their large size translated as presumedly dangerous and hence possibly a brown recluse. *Z. spinimana* only recently became established in the United States (first specimens found in 1995) and is limited to the San Francisco Bay area (Griswold and Ubick 2001), yet 18 specimens were submitted. Both of these species are much larger than any recluse species, have more robust bodies, and multiple dorsal coloration that should exclude them as *Loxosceles* spiders. Of the remaining high-frequency submissions, the cellar spider, *Pholcus phalangioides* (Fuesslin) (Fig. 7), has a darkened cephalic pattern and *Titiotus* spiders have a cephalic setal pattern, both of which were misconstrued as the violin of a brown recluse. Although *Titiotus* spiders do look superficially like *Loxosceles* spiders, the legs of *Pholcus* are much thinner and longer than any recluse spider. *Titiotus* contains 32 species, all from California, only two of which were described previously (Roth 1993) and is a genus that is undergoing revision. Submissions to this study are contributing greatly to the generic revision.

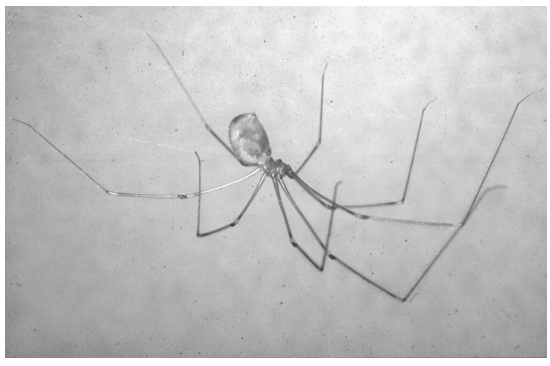

Fig. 7. *P. phalangioides* (Pholcidae).

Public Reaction. An initial goal of this study was to determine the spider characteristics that people were misconstruing as that of a brown recluse. It became evident early in the study that all that was required was some brown somatic coloration and eight legs. The specimens submitted were great in variety, diverse in size and coloration, and had distinctive somatic features. There are currently 68 families of spiders known from North America (Griswold and Ubick 2001); 38 were submitted here. The 30 families not submitted are predominantly minute spiders when mature, rarely collected even by arachnologists, or are found in unique habitats (caves, leaf litter, in tubes in sand dunes, or in the desert) where nonarachnologists would not encounter them. In effect, the participants in this study submitted representatives of almost every family of medium- to large-sized synanthropic spider, including many families that should easily be discounted as possible *Loxosceles* spiders by highly distinct body forms (Thomisidae and Salticidae) or large size (Sparassidae and Pisauridae). A significant number of the general public showed an inability to properly differentiate recluse from nonrecluse spiders even after viewing pictures of *Loxosceles* spiders, including one person who submitted a windscorpion with the comment "it shared some of the aspects of a brown recluse."

Several people from endemic brown recluse areas were fairly certain that they had brown recluses but still wanted a professional opinion. However, several people in nonendemic *Loxosceles* areas were adamant in their ability to correctly identify a spider as a recluse. A few of these were exceptionally vehement and frequently rude because of confidence in their identification with the submissions being wolf and yellow sac spiders (both from Los Angeles, CA), windscorpion (Blythe, CA), and a male orb weaver, *Larinioides patagiata* (Clerck) (Manitowoc, WI). Additional submissions were fraught with arachnophobia especially in regions of the country where *Loxosceles* spiders are extremely rare or have never been found; the degree of anxiety evoked seemed stronger from people in nonendemic *Loxosceles* areas than those who had high probability of encountering the spiders.

Identification and Misidentification of *Loxosceles* Spiders. By far, the most common mistake leading to misidentifications of harmless spiders as brown recluses is the overused statement that one can identify a recluse spider if it has a violin pattern. Although some *Loxosceles* species such as *L. reclusa* are easily

identified by this dark brown violin pattern on the tan cephalothorax (Fig. 1), this oversimplified and dichotomized comment is misinterpreted by nonarachnologists, including medical professionals such that they see violins in the cephalic region of cellar spiders (Pholcidae: *P. phalangioides*, *Physocyclus* spp., *Psilochorus* spp.), male *Kukulcania* spp. (Fig. 3), pirate spiders (Mimetidae: *Mimetus* spp.), the submarginal cephalothorax stripe pattern of funnel weavers (Agelenidae) and wolf spiders (Lycosidae), the dorsal abdominal, leaf-like pattern or median ventral abdominal markings of orb weavers (Araneidae), the dorsal abdominal diamond shapes of *Steatoda triangulosa* (Walckenaer) (Theridiidae), the elongate dorsal abdominal pattern of *Herpyllus ecclesiasticus* Hentz and *Herpyllus propinquus* (Keyserling) (Gnaphosidae), the darkened sternum of *Holocnemus pluchei* (Scopoli) (Pholcidae), as well as other random colorations distributed on all body surfaces. Although the second and more diagnostic line of identification is that *Loxosceles* spiders have six eyes arranged in nontouching pairs (most spiders have eight eyes) may have accounted for the submission of spitting spiders (*Scytodes* spp., Scytodidae), which are closely related to *Loxosceles* taxonomically.

Where Recluse Spiders Are and Are Not Found. Although it might be considered that 1,773 submitted specimens is not a very extensive data set given the nationwide source, these are not randomly collected spiders; all were perceived to possibly be brown recluses by the submitters. The specimens submitted in this study correlate well with the known distribution of *Loxosceles* spiders as presented in the latest genus revision of Gertsch and Ennik (1983), even to the point where in states bordering *Loxosceles* distribution, *Loxosceles* specimens are submitted from the portion within the known distribution. One problem with the map of Gertsch and Ennik (1983) is that the same symbol is used to represent a find of *Loxosceles* spiders, whether it be a perpetual population in Kansas or a single, intercepted itinerant found in California, leading to misinterpretation and exaggeration by medical authors. Additionally, the map generated in this study (Fig. 2) adds credence to anecdotal opinions from southeastern arachnologists: as one gets closer to the Gulf of Mexico, brown recluse populations become scarce. Although northern Louisiana should have brown recluse populations, 94% of the specimens, all non-*Loxosceles*, emanated from the coastal area; of the specimens from Alabama and Georgia, *Loxosceles* species were only submitted from northern areas; and from Texas, which produced 85 *Loxosceles* specimens, only two were submitted from the coastal region.

Recluse spiders are limited in their dispersal potential. Although many other species of spiders disperse widely over habitats by ballooning (i.e., spiderlings emitting a strand of silk, becoming airborne by updrafts and carried long distances), *Loxosceles* spiders are haplogynes; haplogynes do not balloon (Beatty 1970). Gorham et al. (1969) describe a population of *L. reclusa* found under bark of a decomposing oak tree in Georgia that was revisited 7 yr later. Brown recluse spiders were still found in the subsequently rotting tree but none in suitable *Loxosceles* habitat (other fallen logs, wood piles, or an abandoned house) within ≈1 km of the tree, despite intensive searching. Similarly, regarding the *L. laeta* infestation in urban southern California, Waldron (1969) noted when infested structures were razed, new buildings were not reinfested. This brings up the question of how recluse spiders disperse without human assistance, but the existing evidence is that they are not dispersing often beyond their known range.

In conclusion, considering 1) that people can live with dozens to thousands of *Loxosceles* spiders and never show evidence of a bite (Schenone et al. 1970, Vetter and Barger 2002); 2) that the typical brown recluse spider bite is a) self-limiting, b) does not develop severe necrosis or systemic symptoms in 90% of the cases (Wilson and King 1990), and c) often heals without medical intervention (Anderson 1998); and 3) that *Loxosceles* spiders are virtually limited to their endemic areas, there is a minimal chance that a medically important recluse spider bite will occur in a nonendemic *Loxosceles* area. Additional corroboration that alleged brown recluse bites in nonendemic areas are more likely to be misdiagnoses is that several dozen spider submissions were from persons who were diagnosed with recluse bites; none submitted *Loxosceles* spiders. If these bite diagnoses were correct, it seems feasible that *Loxosceles* spiders would occasionally be found at the alleged envenomation locale. Bite diagnoses from nonendemic *Loxosceles* areas must be corroborated with evidence of the incriminated spider. There are many medical conditions that can manifest in necrotic skin lesions (Vetter et al. 2003, Isbister and Whyte 2004, Swanson and Vetter 2005) such that even in endemic *Loxosceles* areas, one cannot accurately ascribe a necrotic skin lesion to the etiology of recluse spider without considering other differential diagnoses. Although the brown recluse spider does on rare occasion cause medically significant lesions, the hyperbole surrounding this spider has exaggerated its significance in North America far out of proportion to its actual risk. There are several other arthropod-borne diseases (West Nile Virus, Lyme borreliosis, and other tick-vectored diseases) that are far more common and potentially dangerous than is brown recluse spider bite. The brown recluse spider continues to garner far more attention and concern than it deserves in nonendemic *Loxosceles* areas.

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