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Kissing Bug (*Triatoma* spp.) Intrusion into Homes: Troublesome Bites and Domiciliation

Stephen A. Klotz¹, F. Mazda Shirazi², Keith Boesen², Norman L. Beatty¹, Patricia L. Dorn³, Shannon Smith¹ and Justin O. Schmidt⁴

¹Division of Infectious Diseases, University of Arizona, Tucson, AZ, USA. ²Arizona Poison and Drug Information Center, University of Arizona, Tucson, AZ, USA. ³Department of Biological Sciences, Loyola University New Orleans, New Orleans, LA, USA. ⁴Southwest Biological Institute, Tucson, AZ, USA.

ABSTRACT: Kissing bugs (*Triatoma* spp.) frequently enter homes and bite human and pet occupants. Bites may lead to severe allergic reactions and, in some cases, death. Kissing bugs are also vectors of *Trypanosoma cruzi*, the cause of Chagas disease. In general, modern houses in the United States are not conducive to domiciliation of kissing bugs (bugs living out their entire life within the home with the presence of eggs, nymphs, adults, and exuviae). Construction features such as concrete foundations, solid walls and ceilings, window screens, tight thresholds for doors and windows, and other measures impede bug entry into homes, and air conditioning reduces the need for open doors and windows. Where Chagas disease is endemic in Mexico and Central and South America, homes often have thatch roofs, adobe walls, and open doors and windows. We investigated numerous instances of kissing bug intrusions into homes in Southern Arizona, California, and Louisiana and documented the reactions to kissing bug bites. Our work confirms the importance of modern home construction in limiting kissing bug intrusions. Older homes, especially those lacking modern screening, caulking, and weather stripping to reduce air leakage, may be subject to kissing bug intrusions and domiciliation. We describe a community in Southern Arizona where domiciliation of homes by *Triatoma recurva* is common. We also provide recent data regarding kissing bug bites and allergic reactions to the bites.

KEYWORDS: kissing bug, triatomine, pest control, home construction, anaphylaxis, bug bites, Chagas disease

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CORRESPONDENCE: sklotz@deptofmed.arizona.edu

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Introduction

Kissing bugs are a potential health hazard,¹ particularly in the southwestern United States (US), where in the foothills surrounding the cities of Tucson and Phoenix, AZ, and San Diego, CA, numerous homeowners are bitten each year. In some cases, bites lead to allergic reactions,^{2,3} including anaphylaxis, the most grave of allergic reactions. Two deaths are attributable to anaphylaxis following kissing bug bites.^{4,5} Most kissing bug entries into homes in the Southwest are short-lived and do not lead to the permanent residence of the bugs in the home. In this report, we will use the terminologies of Noireau and Dujardin⁶ regarding the presence of kissing bugs in houses, namely, (1) *intrusion*, implying the accidental entrance into homes of usually adult kissing bugs attracted by lights or by passive carriage (other life stages of the bugs are not present); (2) *domiciliation*, where adults, nymphs, eggs, and exuviae are found in the home representing a tentative adaptation to the house; and finally (3) *domestication*, which includes domiciliation but with a larger geographic distribution as opposed to just a local phenomenon. A comprehensive collection of publications regarding intrusions and, in some cases, domiciliation in US houses has been

published.⁷ Most of the descriptions are decades old and involve older home constructions. After uncovering domiciliation in one community in the Southwest, we prepared this report to provide a contemporaneous account of the breadth of kissing bug activity in this one community and other US homes.

The absence of domestication as defined earlier is advanced as one explanation for the paucity of autochthonous human Chagas disease in the US.⁴ Generally, newer homes in the US have concrete foundations, solid walls and ceilings, window screens, tight thresholds for windows and doors, and energy efficient measures for the use of air conditioning. In endemic areas of Chagas disease in Central and South America, many houses still have thatch roofs, no foundations, adobe brick or wattle and daub wall construction, and open doors and windows without screens, providing numerous points of entry and refugia for kissing bugs. In one community in Arizona, where domiciliation of homes by kissing bugs appears to be common, the homes have wooden foundations erected over rocky terrain, are advanced in age with numerous points of entry into the house for insects, and are invaded by *Triatoma recurva*, the largest and least studied of kissing bugs in the US.

Methods

Records of kissing bug bites in Southern Arizona.

Kissing bug bites are reported to the Arizona Poison and Drug Information Center, College of Pharmacy, University of Arizona, over telephone. An entry is made into a log of arthropod bites and stings that has been maintained for years. Bite victims are asked questions regarding their reactions to the bite, circumstances of the bite, and environment of the home. Victims are asked to bring the bugs in for identification.

Documentation of entry of kissing bugs into homes.

Homeowners in Arizona frequently call one or more of the authors with complaints of kissing bugs in their homes, invariably after being bitten. The authors respond to these calls by surveying the homes and the environment as well as by collecting kissing bugs from the premises. Kissing bug intrusions and domiciliation in the city of Bisbee, AZ, have been studied by several of the authors, searching homes and identifying kissing bug specimens submitted by the homeowners. Speciation of kissing bugs, nymphal stages, and carriage of *Trypanosoma cruzi* were determined by the authors after specimen collection from homes (in Arizona and Louisiana) or from specimens mailed to the authors by California residents who were interviewed over telephone.

Results

Bites. Typically, the reports of kissing bug bites in Tucson, AZ, begin in late May and extended to August. This time period corresponds with the increasing desert floor temperatures.¹ In 2015, there were 10 calls to the Arizona Poison and Drug Information Center concerning kissing bug bites. Six callers submitted bugs implicated in the bites: one *Triatoma protracta*, male; four *Triatoma rubida*, females; and one *T. rubida*, 2nd instar (*T. rubida* is the most commonly encountered kissing bug in the Tucson area). Of the 10 callers, the average age of the bite victims was 63 years (range, 30–88 years) and 70% of the victims were females and 90% were Caucasian. The characteristics of the homes and reactions to bites are provided in Table 1.

Example of a severe allergy. A case of anaphylaxis due to a kissing bug bite. A man in his 60s from Sahuarita, AZ, came to the emergency room (ER) in August, 2014 with diffuse urticaria (hives), swelling of the airway, and shortness of breath. In the early morning, the patient awakened with nausea, vomiting, palpitations, and diaphoresis that progressed to a syncope episode when he stood up from bed. His wife found a bug in his bed. He had an erythematous swollen area on his left elbow. In the ER, he was intubated for airway protection and was placed on mechanical ventilation. He was administered intravenous fluids, diphenhydramine, and intramuscular epinephrine. The suspected anaphylactic reaction was confirmed with an elevated serum tryptase level. The bug was identified as *T. rubida*. The patient responded well to the treatment and was provided with an EpiPen kit upon discharge from the hospital.

Because no immunotherapy is available for persons with anaphylaxis to kissing bug bites, victims are cautioned about avoiding reexposure and provided epinephrine in a syringe for any repeat episodes. The circumstances surrounding anaphylaxis due to kissing bug bites are monotonously similar with the sudden onset of symptoms, awakening the victim from sleep. Partners of the victims often find a bug or dark excreta on the bedsheets.

Examples of home intrusion. *Single dwelling, New Orleans Parish, LA.* A woman in her 70s and her husband lived in their home for almost 30 years. The house is made entirely of wood and rests on a concrete slab. After experiencing numerous bites from kissing bugs, she sought help and was eventually diagnosed with Chagas disease.⁸ However, her husband, who was also bitten, was not infected. Over a period of years, >500 *Triatoma sanguisuga* were captured in and around their home. Even with extensive searching, only adults were found and no nymphs, eggs, or exuviae were found. Heavy vegetation surrounded the house with several armadillo burrows under the house and an opossum nest in a large tree over the house. This tree reached over an outdoor balcony off the upstairs bedroom where many bugs were found. There were numerous portals of entry into the home. They have built a nearby, raised cottage with air conditioning, window screens, and well-sealed doors and windows, no kissing bugs have been encountered in the new cottage.

Single dwelling, Mariposa, CA. A single man lived in a wood frame house with cedar siding and a composite shingle roof. The foundation was raised using cinder block with many entry points to the basement area, including an open doorway. The basement was dirt. The attic area was closed with one entry door to the outside. An evaporative cooler and a window air conditioner were used in the bedroom. The windows are screened and sealed. Although his bedroom is sealed with

Table 1. Characteristics of victims and their homes.

BITE VICTIM CHARACTERISTICS (n = 10)	RESULT
Age of house	37 years (range 8–77 years)
Screens on windows	80%
Outside night lights	50%
Pets in house	90%
Homeowner saw bugs in house within past month	90%
History of allergy to kissing bug bite	50%
Local skin reaction to bite	100%
Local erythema and itching	90%
Sought medical care for bite	30%
Dizziness after bite	40%
Breathing difficulty after bite	20%

Note: Individuals called the Arizona Poison and Drug Information Center following a kissing bug bite in 2015.



silicone caulking, he was bitten numerous times in this room by adult *T. protracta*. After the latest bite, he fumigated the house with a permethrin-based insecticide and there has been no recurrence of bugs or bites.

Examples of domiciliation by kissing bugs. *Apartment complex in Tucson, AZ.* A woman in her 70s lived with two cats in the foothills of the Catalina Mountains in Tucson, AZ, in a newly constructed retirement village. Over the course of several months (June through August of 2013), she experienced numerous bites from kissing bugs usually after retiring to her bedroom. She collected and stored the bugs. All the bugs were *T. rubida* (Table 2).

The first adult was captured in early June, and the last was captured in early July. Several immature instars were captured from late July to early August. She suffered four bites during the period of infestation. Large welts were formed on the skin adjacent to the bite sites and were very pruritic. She treated these with calamine lotion. Her apartment was sprayed by a pest control company in the first week of June, early on in the infestation. The apartment building was <10 years of age and had central air conditioning. The apartment was part of entire complex of buildings in the foothills of a mountain. Decorative native plants surrounded the complex. One side of her apartment was elevated two stories above the desert with established growths of cholla and prickly pear cacti that likely served as den sites for pack rats (*Neotoma albigula*), a favored host of *T. rubida* and *T. protracta* in the Southwest. The entrance was on the ground floor of a long, dark covered corridor with lights outside of each of the entrance doors kept on 24 hours a day.

Single dwelling, Palm Springs, CA. A woman in her 60s and her husband lived in a recently constructed ranch house in Palm Springs with adjoining desert acreage. They had no pets. She was bitten numerous times by kissing bugs while sleeping. Her husband was not bitten but slept in the same bed. In July, she finally searched the bedroom diligently and found one female and four 2nd instar nymphs of *T. protracta* between the mattress and box springs on her side of the bed. After removal of the bugs, there were no further bites and no further insects were discovered.

Single dwelling, Bisbee, AZ. A man in his 60s and his wife lived in a single dwelling home on the side of a sparsely populated canyon for >20 years. Each year in late June and

July, he noticed the presence of kissing bugs (*T. recurva*) in his home. Over the years, he was bitten several times with only slight pruritus at the bite sites. His house is entirely made of wood (floors, ceilings, and walls). The wooden beams upon which the first floor rests are directly atop large, irregular rock outcroppings. (This is a characteristic feature of most single, freestanding homes in the community.) There are screens on the windows, but no air conditioning. The couple has no pets. For seven years, the owner has been collecting kissing bugs in the home and sending them to the authors for identification. Four years ago, he constructed a bedroom about 100 feet from his infested house. It is also surrounded by rocky projections. The foundation is concrete, and the walls are concrete block with stucco wall surfaces. He has never seen a kissing bug in this building in contrast to his longtime home that continues to be infested. He collects on an average 30 *T. recurva* per year in the house, mostly adults and some nymphs, particularly 4th and 5th instars. Another resident in the canyon (in her 70s) has also been collecting kissing bugs from her home for the same period of time. Her home, like the previous one, is entirely made of wood, with a wood foundation resting directly on the soil and rock outcroppings. She typically collects more bugs (perhaps 30–60 per year, sometimes with a preponderance of 4th and 5th instars). All bugs collected are *T. recurva*. She has one dog living with her who is also bitten.

Single dwelling, city center of Bisbee, AZ. One woman in her 60s lives in a single dwelling house within the central part of Bisbee. The house was constructed decades ago, which has a wood frame with concrete floors and stucco walls. There is little space between the front of the house and the street and it is entirely given over to a rock garden. The streets near the home are steep and demarcated by rock walls, offering numerous refugia for insects. The homeowner routinely finds adult *T. recurva* in her home and on the retaining walls along the streets. The entrance doors to her home are several inches from the threshold, and the windows and doors are not occlusive, although screens are present. She typically collects 15–30 *T. recurva* each year in her home, both nymphs and adults. She has no pets and claims to have been bitten over a hundred times in the years she has resided in Bisbee. Her home is about half mile from the canyon homes described earlier. These observations demonstrate that the largest kissing bug in the US, *T. recurva*, lives freely within the city confines of Bisbee or flies from the surrounding mountains. *T. recurva* is known to fly perhaps a mile, or more, in the canyon environment.⁹

Discussion

This report documents the continuing problem of kissing bug bites, particularly in Southwest communities whose growth encroaches upon the habitat of the usual sylvan hosts of these bugs. Home intrusion by kissing bugs is for the most part a transient, seasonal occurrence. Only rarely is there domiciliation and usually in older homesteads with multiple entry sites lacking appropriate pest control measures. Domiciliation

Table 2. Kissing bugs captured in an apartment residence with evidence of domiciliation.

SEX	NUMBER	STAGE OF MATURATION	WHERE FOUND IN HOME
M	4	Adult	bathroom, bedroom
F	1	Adult	bathroom
Nymph	4	1st and 2nd instar	not noted



is occurring in Bisbee, AZ, and may be due to the terrain, upon which the homes are built, which is the natural habitat of *T. recurva*. A study of *T. recurva* performed in Sabino Canyon (similar in terrain to Bisbee) reported that *T. recurva* could fly perhaps a mile or more.⁹ Thus, it is possible that *T. recurva* is flying into the city center from surrounding canyons. *T. rubida* and *T. protracta* favor lower foothills and a more gravel/dirt terrain with plentiful pack rat nests. *T. sanguisuga* in southern Louisiana is usually found around the bodies of water; indeed, the most common blood source in the New Orleans bugs was frogs.¹⁰ This is quite different from *T. sanguisuga* found in drier Texas.¹¹

Home intrusion is usually accompanied by bites, some of which result in severe allergic reactions, such as anaphylaxis like the example given in this report. This cause of anaphylaxis is easily overlooked in busy ERs where physicians begin with the preconception that the life-threatening condition is due to drugs or foods. However, some victims are aware of being bitten and may bring in the kissing bug and the cause can be established. However, many people with anaphylaxis from kissing bug bites are unaware of being bitten, which occurs while they are sleeping. The clue to the problem resides in the history: victims arise from sleep with the abrupt onset of shortness of breath and whole body pruritus. It is evident from the data from the Arizona Poison and Drug Information Center that every patient experienced a local reaction to the bite and many experienced more troublesome symptoms, such as dizziness (40%) and breathing difficulty after the bite (20%); 30% of the victims sought medical care following the bite (Table 1). Many homeowners with kissing bug intrusions contracted with pest control services and experienced no recurrence of bites in the same season.

This report documents that house structure is important in preventing intrusion by kissing bugs in the US. The two examples of homes with kissing bug intrusion were older structures with many portals of entry for the bugs. The home in New Orleans Parish is instructive in several ways. The homeowners built a bedroom adjacent to the home with air conditioning and have experienced no bug intrusions into the bedroom. For some unknown reasons, only adult bugs have been found in this home. Domiciliation of kissing bugs occurred mostly in older homes with multiple portals of entry for the bugs. In the case of houses in Bisbee, AZ, many of the foundations were made of wood placed directly on large boulders. At one residence, the homeowners built a bedroom with air conditioning not far from the main house and sealing to minimize air loss has prevented the intrusion of bugs for years, whereas the main house remains a domicile for nymphal and adult kissing bugs. In Tucson where *T. rubida* is the most common kissing bug, domiciliation may follow intrusion by dispersing gravid female bugs that lay eggs inside the home within days of entry. The homes domiciliated in Bisbee, AZ, were occupied by *T. recurva*, the largest and least studied of US kissing bugs. At least 10 homes in one canyon community

are occupied by kissing bugs every year, and the occupants of the houses sleep under mosquito netting year-round. The almost exclusive finding of *T. recurva* in Bisbee may be a clue to their preferred habitat of rocky canyon walls, and perhaps *T. recurva* may be more amenable to domiciliation than *T. rubida*, *T. protracta*, or *T. sanguisuga*.

The kissing bug species involved in this study harbor *T. cruzi*, but autochthonous cases of Chagas disease are extremely rare with seven documented cases to date.⁴ The rates of parasite carriage vary considerably. For example, in recent studies in Tucson, AZ, *T. cruzi* was found by polymerase chain reaction (PCR) in 25% of wild caught *T. rubida* (32/128 total bugs) and 35.3% of *T. protracta* (6/17)¹²; a study involving *T. rubida* captured in the home and peridomestic area showed a rate of carriage of *T. cruzi* of 41.5% (68/164).¹³ Kissing bugs captured from the home in New Orleans Parish where the homeowner was infected with Chagas disease demonstrated that 59.2% (29/49) harbored *T. cruzi*.¹⁰ Twenty-one of 49 bugs fed upon humans, and 8 (38.1%) of those feeding on humans harbored *T. cruzi*. Therefore, there is a risk for transmission of *T. cruzi* among these US bugs, although demonstration of infection is rare.

One factor thought to be important in the transmission of *T. cruzi* to humans is the rate of defecation after feeding (defecation index). This rate is low in bugs caught in Tucson and fed on living hosts.¹⁴ Another study claimed higher defecation rates, but the bugs were fed sodium-citrated blood.¹⁵ The anticoagulated blood may have affected the defecation rate. Although the carriage of *T. cruzi* is appreciable among US bugs, the type of housing appears to protect homeowners likely aided by a low defecation index among the bugs.¹⁶

Author Contributions

Conceived and designed: SAK, PLD, JOS. Analyzed the data: SAK, PLD, JOS. Wrote first draft: SAK. Contributed to writing: JOS, PLD, NB, SAK. Agree with results: SAK, FMS, KB, NLB, PLD, SS, JOS. Developed structure: JOS, PLD, SAK. Made critical revisions: JOS, SAK. All authors reviewed and approved of the final manuscript.

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