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Further Eastern Range Extension and Host Records for *Leptoglossus Occidentalis* (Heteroptera: Coreidae): Well-Documented Dispersal of a Household Nuisance

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FURTHER EASTERN RANGE EXTENSION AND HOST RECORDS FOR *LEPTOGLOSSUS OCCIDENTALIS* (HETEROPTERA: COREIDAE): WELL-DOCUMENTED DISPERSAL OF A HOUSEHOLD NUISANCE

Wayne K. Gall[1]

ABSTRACT

Leptoglossus occidentalis is reported for the first time from Connecticut, New York, Ontario, Pennsylvania, and Wyoming, representing an eastern range extension from Indiana and Michigan. *Tsuga canadensis* and *Pinus mugo* are added to the long list of coniferous hosts of this coreid. Approximately 233 of 316 northeastern specimens were collected inside or on the outside of buildings from August-May, confirming previous observations that *L. occidentalis* uses buildings for overwintering. Isolated records from Connecticut and eastern Pennsylvania suggest human-mediated dispersal may augment its natural dispersal. The pattern of distribution records on a map of North America identifies *L. occidentalis* as one of the best documented examples of a native insect expanding its range eastward in North America. Striking differences in the color pattern of the abdominal dorsum facilitates separation of the closely related *L. occidentalis* and *L. corculus*.

McPherson et al. (1990) reported new distribution records for *Leptoglossus occidentalis* Heidemann (Heteroptera: Coreidae) from Illinois, Michigan, and confirmed one previous record from Indiana. They cited previously published records which suggest that this coreid, originally perceived as an element of the western fauna, has been expanding its range eastward.

This paper reports new distribution and host records for *L. occidentalis*, historically documents the eastward expansion of its range on a map, proposes the use of color pattern of the abdominal dorsum as a diagnostic character to differentiate the morphologically similar *L. occidentalis* and *L. corculus* (Say), and discusses the aesthetic nuisance which this bug causes when it enters homes seeking overwintering sites.

In western North America, *L. occidentalis* has been reported to feed on the seeds of cones (especially developing cones) of at least ten species of conifers, as well as some hybrids of these species (Koerber 1963, Krugman and Koerber 1969, Hedlin et al. 1980). Five additional species of native or introduced conifers have been reported as food plants in central and eastern North America (Schaffner 1967, Katovich and Kulman 1987, McPherson et al. 1990). Its direct economic impact results from reducing the quality and/or viability of conifer seed crops, since feeding tests in western North America indicate it has the potential of feeding on the seeds of most commercially important conifers there (Hedlin et al. 1980, Koerber 1963, Krugman and Koerber 1969).

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Here I report first records of *L. occidentalis* feeding on *Tsuga canadensis* and *Pinus mugo* (both Pinaceae), thus adding to the already lengthy list of coniferous hosts of *L. occidentalis*. On 28 July 1991, I collected 18 adults and 2 nymphs of *L. occidentalis* feeding on *T. canadensis* in a suburban yard in western New York (Town of Orchard Park, Erie County). The proboscis of these bugs was directed ventrad, perpendicular to the long axis of the body, and with one exception, penetrated the developing (i.e., green, unopened) cones; the one exception appeared to have its proboscis inserted into a branchlet of the new year's growth. At the same site on the same day, I also observed two adults of *L. occidentalis* similarly feeding on developing cones of *P. mugo*. Further details of the feeding habits and life history of this species are provided by Koerber (1963), Krugman and Koerber (1969), Hedlin et al. (1980), and McPherson et al. (1990).

METHODS

During the period January, 1990 to March, 1992, I collected or examined approximately 300 specimens of *L. occidentalis* from western and central New York, and southern Ontario. They were submitted for identification to the Buffalo Museum of Science, Cornell Insect and Plant Disease Diagnostic Laboratory (Ithaca, NY), Genesee County Cooperative Extension (Batavia, NY), Niagara County Cooperative Extension (Lockport, NY), Royal Ontario Museum (Toronto), and University of Guelph (Ontario), by concerned persons who found these relatively large, conspicuous bugs (length 16–20 mm) inside or congregating on the outside of their homes from late summer to early spring. These specimens represent the first distribution records for New York and Ontario, and indicate that this bug is continuing to expand its range eastward.

S.A. Marshall and J.E. Swann loaned me 48 specimens of *L. occidentalis* from the University of Guelph Insect Collection, including the earliest record (November, 1985) of this species from Ontario. Marshall (1992) postulates that this bug moved into southern Ontario from adjacent southeastern Michigan, where the earliest published records are from 1983 (McPherson et al. 1990). The loan from Guelph also included one *L. occidentalis* from Wyoming, the first record for that state.

A.G. Wheeler, Jr. (pers. comm.) provided two unpublished records of *L. occidentalis* from Pennsylvania, representing the first records for that state. The single specimen from York Co. in eastern Pennsylvania is especially interesting, since it was intercepted in a rail shipment of corn from Mendota, Illinois. The new records for *L. occidentalis* in New York, Ontario, and Pennsylvania, known to me through March, 1992, are shown in Figure 1.

A first record for Connecticut was also provided by R.J. Packauskas (pers. comm.), who reported a single specimen collected on a Christmas tree [Douglas fir, *Pseudotsuga menziesii* (Pinaceae)] in a house in December, 1985.

Ironically, I also discovered in my personal collection one *L. occidentalis* which I had collected in south central Wisconsin in October, 1979, while I was a graduate student at the University of Wisconsin at Madison. This record is six years earlier than the only published record for Wisconsin of which I am aware (Katovich and Kulman 1987). The distribution of *L. occidentalis* in North America, including the records reported here, is shown in Figure 2.

Specimens were identified using the key to species of *Leptoglossus* north of Mexico provided by McPherson et al. (1990). Unless specified otherwise, specimens were identified by the author, and deposited at the Buffalo Museum of Science, Buffalo, NY. Specimens have also been deposited at the

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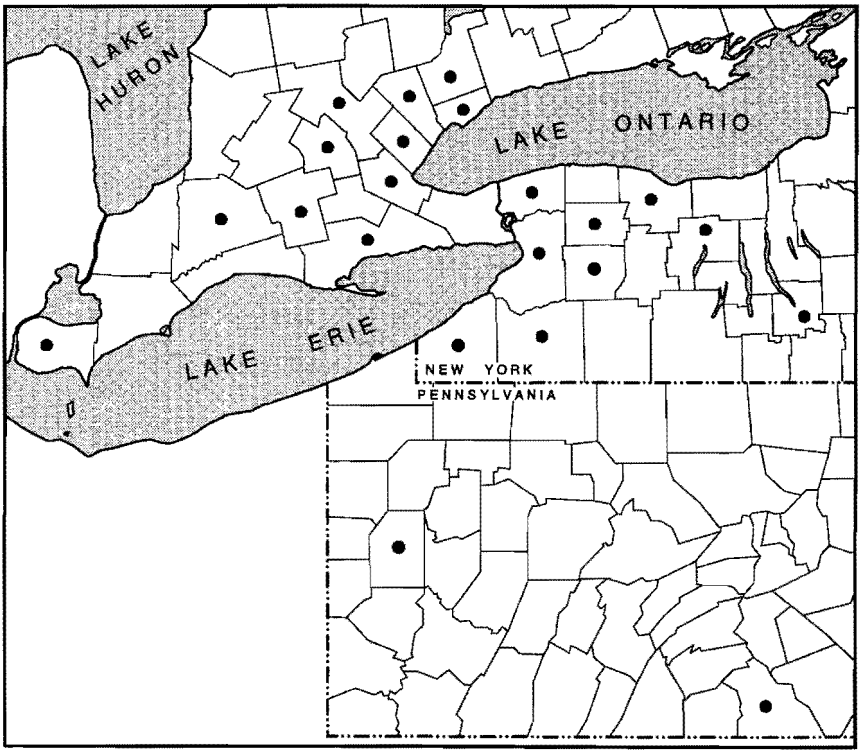

Figure 1. Records of *Leptoglossus occidentalis* by county or regional municipality in New York, Ontario, and Pennsylvania.

Canadian National Collection, Biosystematics Research Centre, Ottawa (CNC); collection of the Insect and Plant Disease Diagnostic Laboratory, Cornell Cooperative Extension, Ithaca, NY (IPDDL); Cornell University Insect Collection, Ithaca, NY (CUIC, Voucher Specimens Lot #1208); Bureau of Plant Protection, Pennsylvania Department of Agriculture, Harrisburg (PDA); Royal Ontario Museum, Toronto (ROM); the University of Guelph Insect Collection, Guelph, Ontario (UGIC); and the Yale Peabody Museum, New Haven, Connecticut (YPM).

COLLECTION RECORDS

Label data are as follows: **CONNECTICUT, Fairfield Co.**: Fairfield, douglas fir Christmas tree, 27 Dec. 1985, coll. DJ Comboni, det. RJ Packauskas, YPM. **NEW YORK, Cattaraugus Co.**: Town of Machias, in unheated shed, in and around cardboard boxes, 15 Feb. 1992 (8 ♂♂, 4 ♀♀), coll. KV Anderson. **Chatauqua Co.**: Town of North Harmony, on window curtain in upstairs bedroom of house, 22 Feb. 1992. (♀), coll. JE Skinner. **Erie Co.**: Town of Amherst, East Amherst, in house, 13 Oct. 1990 (1♂), coll. L Stewart; on

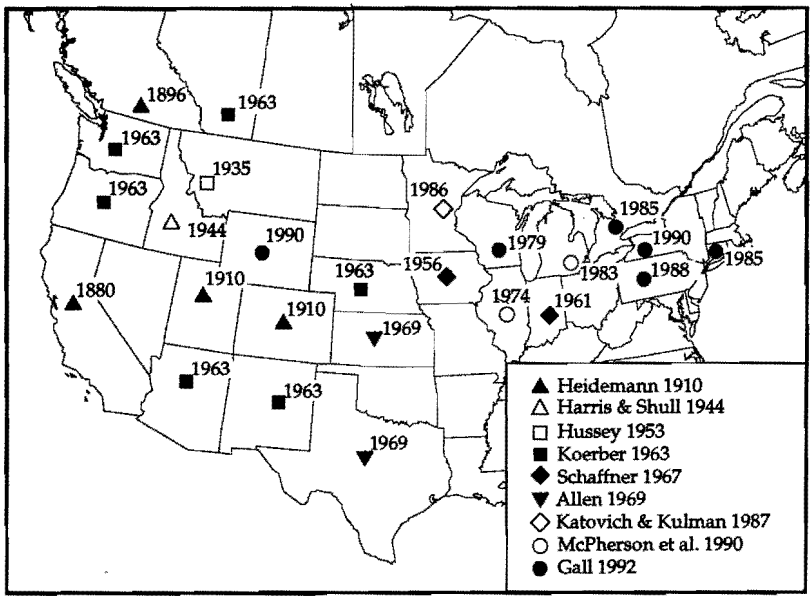

Figure 2. First published records of *Leptoglossus occidentalis* in North America by state or province. Dates of first collection are indicated on the map when available in the respective publications.

outside of house, 16 Nov. 1990 (5 ♂♂, 7 ♀♀), coll. T and L Stewart; on outside of house (11 ♀♀, 6♂♂), in attic (1 dead/sprayed ♂), on outside of outbuilding (1 nymph), 26 Nov. 1990, coll. WK Gall et al., CUIC (1 ♂, 1 ♀ voucher specimens); on outside wall or inside house, 3–17 Dec. 1990 (5 ♂♂, 8 ♀♀), coll. D Brassel; on head of guest arriving at house, 8 Dec. 1990 (1 ♂), coll. J Goldfarb. Town of Amherst, North Campus, State University of NY at Buffalo, on *Pinus nigra* (Pinaceae), 12 Sept. 1991 (7 ♂♂, 14 ♀♀), coll. WK Gall, CUIC (1 ♂, 1 ♀ voucher specimens). Town of Amherst, in house, late Dec. 1991 (1 ♀), coll. K Tarbell. Town of Aurora, on outside of screen door of house, 1 Nov. 1990, coll. P Matlock, CUIC (1 ♂ voucher specimen); on wooden siding of outbuilding (4 ♂♂), on cedar shingle siding of home (1 ♂, 1 ♀), in spider webs outside windows of homes (2 ♂♂ dead), 2 Nov. 1990, coll. WK Gall; on kitchen stove in house, 9 Nov. 1990 (1 ♂), coll. P Matlock; in second floor bathroom of house, 15 Nov. 1990 (1 ♂), coll. J Hagner; between storm and inner windows of house, 15 Nov. 1990 (1 ♀ dead), on outside of house and outbuilding (1 ♂, 4 ♀♀), coll. WK Gall, CUIC (1 ♀ voucher specimen); on davenport in house, 14 Aug. 1991 (1 ♀), on living room floor near fireplace, 17 Aug. 1991 (1 ♀), on outside of overhead garage door, 22 Aug. 1991 (1 ♀), on floor of living or dining room of house, Sept.-Oct. 1991 (7 ♂♂, 5 ♀♀), in bedroom of house, 6 Oct. 1991 (1 ♂), in living room of house, 14 Oct. 1991 (1 ♀), on inside of screen door, dining room of house, 22 Oct. 1991 (1 ♂), in living room and kitchen of house, 7–8 Nov. 1991 (1 ♂, 2 ♀♀), coll. PY Matlock, CUIC (1 ♂, 1 ♀ voucher specimens); in house around first floor window, 23 Oct. 1991 (1♀), coll. R Ogorek. City of Buffalo, Tifft Nature Preserve, in log cabin visitor center, 7 Apr. 1990 (1 ♂), coll. K

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Alexander-Thomson; Martin Luther King Park, feeding on green cones of *Pinus nigra*, 8–9 Aug. 1991 (2 ♀♀), on unripened cone of *Pinus nigra*, 3 Sept. 1991 (1 ♀), reared ex. nymph coll. on unripened cone of *Pinus nigra*, 12 Sept. 1991 (1 ♀), coll. WK Gall. Town of Colden, inside house, S Irish Road, 2 Nov. 1991 (2 ♂♂), 29 Nov. 1991 (2 ♀♀), coll. TW Gavin; in basement of house on wooden bureau, Rt. 240, 1 Dec. 1991 (1 ♀), coll. C Gavin. Town of Concord, in house on lampshade, mid-Nov. 1991 (1 ♀), coll. A Edmunds. Town of Eden, found dead in sun porch of house, Fall 1991 (1 ♀, 1♀), coll. HL Bosworth. Town of Holland, in house, 18 Dec. 1991 (1 ♂), coll. MT Dann. Village of Lancaster, in kitchen cupboard of house, 3 Feb. 1992 (1♂), coll. HM Graves. Town of North Collins, stuck to tape of fruit basket in house, 24 Dec. 1991 (1 ♀), coll. EE Both. Town of Orchard Park, in house, 1 Oct. 1990 (1 ♂), early Oct. 1990-early Jan. 1991 (6 ♂♂, 5 ♀♀), CUIC (1 ♂, 1 ♀ voucher specimens), early Jan.-late Apr. 1991 (13 ♂♂, 11 ♀♀), CUIC (1 ♂, 1 ♀ voucher specimens), in dining room, 28 Apr. 1991 (1 ♀), inside terrace window, 27 Apr. 1991 (2 ♂♂, 2 ♀♀), 30 Apr. 1991 (1 ♂), 1 May 1991 (2 ♀♀), on fence, 11 July 1991 (1 nymph), coll. E Gugino; feeding on green cones or branchlet of *Tsuga canadensis* (12 ♂♂, 6 ♀♀, 2 nymphs), feeding on green cones of *Pinus mugo* (1 ♂, 1 ♀), feeding on green cone of *Pinus nigra* (1 ♀), 28 July 1991, coll. WK Gall, C & E Gugino; on inside of window of second floor bathroom of house, Oct. 1991 (1 ♀), coll. J Norcross; in house on shirt which had been dried outside on clothesline, 2 Nov. 1991 (1 ♂), in living room of house, 11–12 Nov. 1991 (2 ♀♀), coll. H MacMurray. Village of Orchard Park, at picture window in converted carriage house, 20 Jan. 1990 (1 ♀), coll. J Norcross. Town of West Seneca, in kitchen of house, 18 Nov. 1991 (1 ♀), outside house on porch, 5 Mar. 1992 (1♂), coll. R Seivert. **Genesee Co.**: Town or City of Batavia (in house?), 20 Oct. 1991 (2 ♀♀), 31 Oct. 1991 (1 ♂), submitted to R Twichell, Genesee County Cooperative Extension. **Monroe Co.**: Penfield, 18 Mar. 1991 (1 ♂, 1 ♀), submitted to C Klass, Cornell Cooperative Extension, IPDDL. **Niagara Co.**: Village of Lewiston, in home, 14 Feb. 1992 (1 ♂, 2 ♀♀), coll. T Dexter, submitted to J Farfaglia, Niagara County Cooperative Extension. **Ontario Co.**: Victor, 14 Jan. 1992 (1 ♂, 1 ♀), coll. M Woods, submitted to C Klass, Cornell Cooperative Extension, IPDDL. **Tompkins Co.**: Town of Danby, in home, 27 Jan. 1992 (1 ♂), coll. and det. C Klass, IPDDL. Town of Ithaca, in kitchen and living room of house, 2–4 Dec. 1991 (1 ♂, 1 ♀), coll. ML Thayer. Town of Ulysses, Taughannock Falls State Park, reared ex. nymph coll. on unripened cone of *Pinus nigra*, 8 Sept. 1991 (1 ♀), coll. WK Gall. **Wyoming Co.**: Town of Wethersfield, in house(?), late Nov. 1991 (1♀), D. Junkin; Town of Java, on kitchen floor in house, 8 Feb. 1992 (2♀♀), S. Burton. **ONTARIO, Essex Co.**: Kingsville, on pine needle, 25 Sept. 1987 (1 ♀), coll. K Petrile, GUIC. **Halton Regional Municipality**: Oakville, 11 Apr. 1991 (1 ♀), coll. JP Haynes, GUIC. **Middlesex Co.**: London, 10 Sept. 1989 (1 ♀), coll. R Rea, GUIC. **Hamilton-Wentworth Regional Municipality**: Binbrook, 13 Oct. (1 ♀), L Craig, GUIC. **Metropolitan Toronto**: City of Etobicoke, between sliding windows of home, 29 Jan. 1991 (1 ♂ dead), JD Kerr; in house, 8 Dec. 1991 (1 ♂), coll. A Wright, ROM; in house, 10 Dec. 1991 (2 ♂♂, 2 ♀♀), in firewood brought into house, 16 Dec. 1991 (1 ♂), crawling on wastebasket in house, 16–20 Dec. 1991 (1 ♀), coll. SW Beke, ROM. City of North York, at window of house, 14 Mar. 1991 (1 ♂), coll. EC Wiggins, ROM; in house behind drapes, 18 Nov. 1991 (1 ♀), AL Pearce, ROM. City of Scarborough, on outside wall of fourth floor balcony of apartment building, 9 Oct. 1991 (1 ♂, 1 ♀), coll. AE Copping, ROM; in house, 13 Feb. 1991 (1 ♀), coll. SR Hatt, ROM. **Norfolk Co.**: Delhi (inside buildings, Delhi Research Station), 9 Oct. 1990 (3 ♂♂, 3 ♀♀), coll. HH Cheng and JJ Hanlon, det. MD Schwartz, CNC; 22 Apr. 1991 (1 ♂), 4 Oct.-21 Nov. 1991 (8 ♂♂, 2 ♀♀), coll. JJ Hanlon, CUIC (1 ♀ voucher specimen). Simcoe, in house, 20 Oct. 1991 (1 ♀), coll. JJ Hanlon. **Oxford Co.**: Tillsonburg, on outside of house, 7–8 Oct. 1991 (1 ♂, 1 ♀), coll. JJ Hanlon, CUIC (1 ♂ voucher speci-

men). **Peel Regional Municipality**: Caledon, household, 19 Nov. 1991 (1 ♀), coll. D Finkle, GUIC; Mississauga, front door, 30 Sept. 1991 (1 ♂), coll. T Bradley, GUIC; Miss(issauga?), 18 Sept. 1991 (1 ♀), coll. J Logan, GUIC. **Waterloo Regional Municipality**: Cambridge, screen door, 20 Oct. 1991 (1 ♂), coll. J Allan, GUIC; Kitchener, on sidewalk, 5 Oct. 1990 (1 ♀), coll. BD Totzke, GUIC. **Wellington Co.**: Fergus, 15 Oct. 1990 (1 ♀), coll. and det. SA Marshall, GUIC; Guelph, in house, 13 Nov. 1985 (1 ♂), coll. H McLeod, det. SA Marshall, GUIC; Guelph, Mills Hall, 20 Sept. 1988 (1 ♂), M Gervais, GUIC; Guelph, interior house, 10 Oct. 1990 (1 ♀), coll. SA Kells, GUIC; Guelph, garden, 12 Oct. 1990 (1 ♀), T Rajotte, GUIC; Guelph, leaf litter, 13 Oct. 1990 (1 ♀), coll. E Stewart, GUIC; Guelph, building, 20 Oct. 1990 (1 ♀), coll. NJ Maas, GUIC; Guelph, backyard, 20 Aug. 1991 (1 ♂), coll. D Bennett, GUIC; Guelph, yard, 13 Sept. 1991 (1 ♂), coll. J Godfrey, GUIC; Guelph, Riverside Park, 16 Sept. 1991 (1 ♀), coll. J Witt, GUIC; Guelph, 16 Sept. 1991 (1 ♂), coll. D Stephens, GUIC; Guelph, suburban front yard, 28 Sept. 1991 (1 ♀), coll. M Teppo, GUIC; Guelph, indoors, 30 Sept. 1991 (1 ♀), coll. and det. P Richards, GUIC; Guelph, University of Guelph, in second floor dormitory room, Oct. 1991 (1 ♀), coll. N Tzovolos, ROM; Guelph, inside building, 2 Oct. 1991 (1 ♀), coll. CS Blaney, GUIC; Guelph, Cutten Club, 3 Oct. 1991 (1 ♀), coll. S Hansen, GUIC; Guelph, window Gra(ce?) H(all?), 3 Oct. 1991 (1 ♀), coll. J Hergott, GUIC; Guelph, 5 Oct. 1991 (1 ♀), coll. P Brown, GUIC; Guelph, 7 Oct. 1991 (1 ♀), coll. P Reilly, GUIC; Guelph, window, 8 Oct. 1991 (1 ♀), coll. N Catapay, GUIC; Guelph, pile of leaves, 8 Oct. 1991 (3 ♀♀), coll. ML McCune, GUIC; Guelph, window ledge, 10 Oct. 1991 (1 ♀), coll. DW Nesbitt, GUIC; Guelph, on window, 10 Oct. 1991 (1 ♂), coll. KE Faller, GUIC; Guelph, 10 Oct. 1991 (1 ♂), coll. R Rea, GUIC; Guelph, Speed River edge, 15 Oct. 1991 (1 ♂), coll. J Allan, GUIC; Guelph, South. Res., 15 Oct. 1991 (1 ♀), coll. SA Cottenden, GUIC; Guelph, field, 15 Oct. 1991 (1 ♂), coll. MA Steel, GUIC; Guelph, urban garden, 15 Oct. 1991 (1 ♀), coll. C Jones, GUIC; Guelph, sidewalk, 18 Oct. 1991 (1 ♀), coll. C DeMooy, GUIC; Guelph, grassy field, 23 Oct. 1991 (1 ♀), coll. D Scabrooke, GUIC; Guelph, 24 Oct. 1991 (1 ♀), coll. R Rea, GUIC; Guelph, 27 Oct. 1991 (1 ♀), coll. J Taylor, GUIC; Guelph, arboretum, 30 Oct. 1991 (1 ♂), coll. P Cimetta, GUIC; Guelph, doorstep, 26 Nov. 1991 (1 ♂), coll. MC Leiskau, GUIC; Guelph, Stone Rd., in house, 15 Jan. 1992 (1 ♂), coll. RA Cannings, GUIC. **York Regional Municipality**: Richmond Hill, in house, 13 Dec. 1990 (1 ♀), coll. P Parmenter, ROM. **PENNSYLVANIA, Butler Co.**: Buffalo Township, 3.7 km. east of Sarver, in house in good numbers, Dec. 1991 (4 ♂♂, 2 ♀♀), coll. CW Bier, det. AG Wheeler, Jr., PDA; **York Co.**: City of York, intercepted in rail shipment of corn from Mendota, Illinois, early Oct. 1988 (1 ♂), det. AG Wheeler, Jr., PDA. **WISCONSIN, Sauk Co.**: Parfrey's Glen, 7 Oct. 1979 (1 ♂), coll. WK Gall. **WYOMING**: Black Hills Nat. For., Cook Lake Recreation Area, 20 Aug. 1990 (1 ♂), JE Swann, GUIC.

DISCUSSION

Approximately 233 (232 adults, 1 nymph) of the 316 specimens reported above from Connecticut, New York, Ontario, and Pennsylvania were collected inside or on the outside of buildings from mid-August to early May, the majority collected during October and November. This well-documented association of *L. occidentalis* with buildings in northeastern North America supports the previously published observations in central (McPherson et al. 1990, Schaffner 1967) and western North America (Spencer 1942) that *L. occidentalis* will enter buildings while seeking protected overwintering sites at the onset of cold weather. Other overwintering sites reported for this bug are under pine

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bark (Downes 1927), in dead, dry douglas firs (Dennys 1927), and in the nests of a hawk and rodent (Hussey 1953). In the new records reported above, the latest date *L. occidentalis* was collected inside a building was 1 May. This is reasonably consistent with published observations in California, where adults emerge from overwintering sites from mid-May to early June to feed, mate, and oviposit on needles of the host tree (Hedlin et al. 1980, Koerber 1963, McPherson et al. 1990).

All *L. occidentalis* collected inside or on the outside of buildings in western and central New York were surrounded by, or in close proximity to, one or more species of conifers. For example, in Erie County, New York, large numbers of *L. occidentalis* were found inside or on the outside of homes in Orchard Park and Aurora situated near stands of mature specimens of *Pinus nigra*, *Pinus resinosa*, *Pinus strobus*, and *Pinus sylvestris*, and smaller numbers of at least some of the following conifers: *Pinus mugo*, *Thuja occidentalis* (Cupressaceae), *Picea glauca*, *Picea abies*, *Tsuga canadensis*, and *Abies concolor* (all Pinaceae unless otherwise indicated). Forty-three *L. occidentalis* were collected inside or on the outside of an Amherst home which was adjacent to a dense stand of several dozen mature *Pinus strobus*; at the time of collection in November, 1990, the ground was littered by fallen cones, indicating a good cone crop that year.

Interestingly, only one specimen of the closely related *Leptoglossus corculus* was collected in association with buildings during this study, compared with the 233 specimens of *L. occidentalis* found in similar circumstances: an adult female (Figs. 3 c, d) on the outside (cedar shingle siding) of a home in the Town of Aurora, Erie County, NY, 2 November 1990, in the company of several *L. occidentalis*. The only other specimen of *L. corculus* that I have collected in western and central New York was an adult female (Fig. 3 e,f) on *Pinus nigra* in Sampson State Park, Seneca County, 31 Aug. 1991, where I checked dozens of cone-bearing *Pinus nigra* planted along roadways and the campground. These trees harbored several early instar nymphs of an unidentified species of *Leptoglossus*, but no adults of *L. occidentalis* were observed. The relative rarity of *L. corculus* in western and central New York most likely results from it being at the northern limit of its range in New York State (Allen 1969, Henry and Froeschner 1988, Hedlin et al. 1980). In fact, the range map of Hedlin et al. (1980) shows this species, a pest of several pines in the southeastern U.S., penetrating New York State only in the extreme southeastern corner. Although Hedlin et al. (1980) report adults of *L. corculus* hibernating in various protected spots, I have not seen any published records of this species hibernating in buildings. Since populations of *L. occidentalis* and *L. corculus* are probably coming into contact for the first time as a result of the eastward spread of *L. occidentalis*, this recently established sympatry may provide ecologists, ethologists and systematists with interesting opportunities to investigate competitive interactions, partitioning of food resources, and interbreeding or maintenance of reproductive isolation between these closely related species. Allen (1969) placed these two species together in the *corculus* group with *L. clypealis* Heidemann, although he did not provide an explicit phylogeny of the genus.

ABDOMINAL COLOR PATTERN

In couplet 8 of the key to species of *Leptoglossus* north of Mexico provided by McPherson et al. (1990), *L. occidentalis* and *L. corculus* are separated on the basis of the relative lengths of the inner vs. outer dilation of the hind tibia (nearly equal in *occidentalis*, outer distinctly longer than inner in *corcu-*

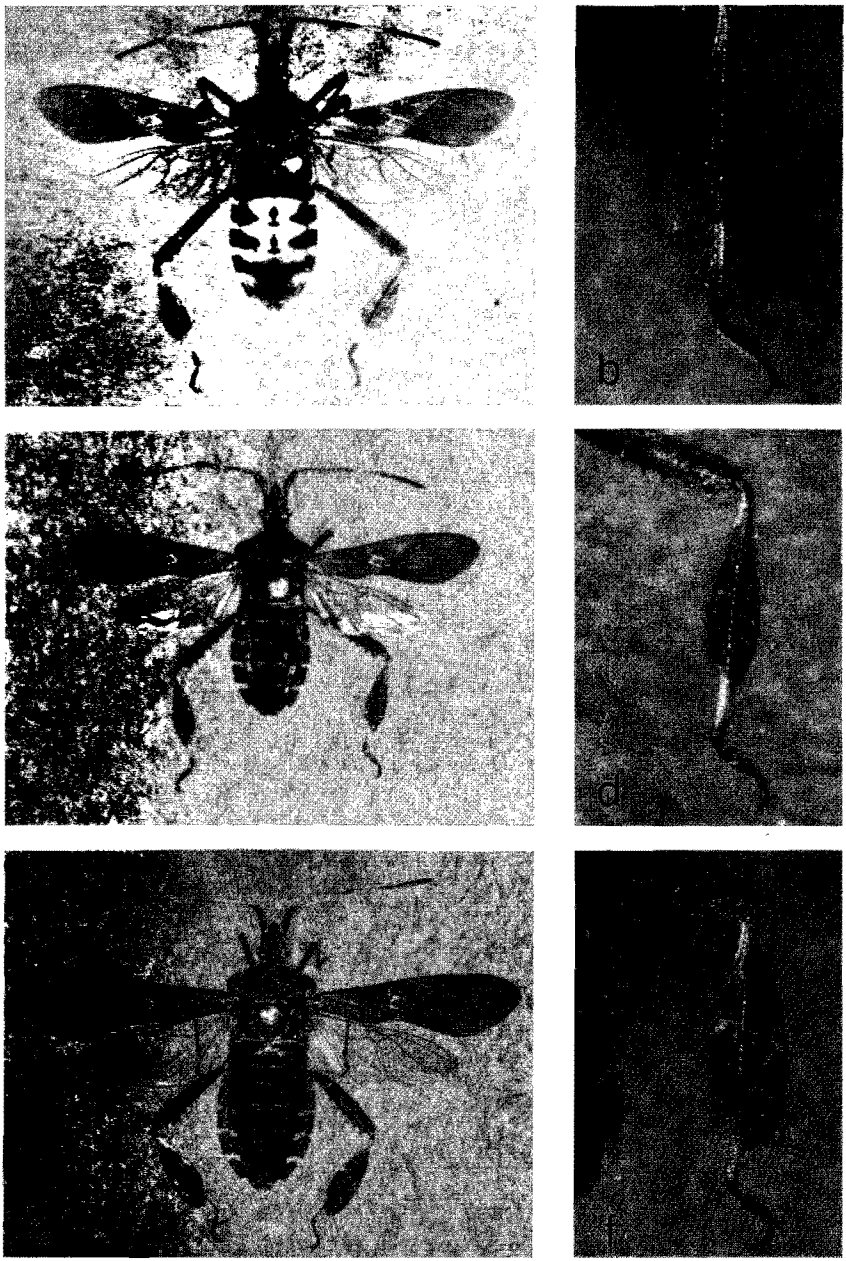

Figure 3. Color pattern of the abdominal dorsum and closeups of the right hind tibiae of *Leptoglossus* spp. a,b: *L. occidentalis*, Erie County, NY; c,d: *L. corculus*, Erie County, NY; e,f: *L. corculus*, Seneca Co., NY.

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lus), and the shape of the median notch in the posterior margin of the genital capsule (subrectangular in *occidentalis*, roundly V-shaped in *corculus*). During this study, some specimens referable to *L. occidentalis* (mostly females) had the outer dilation noticeably longer than the inner (compare Fig. 3b, with Figs. 3d and 3f), and conversely, one specimen referable to *L. corculus* (identified by E.R. Hoebeke) had a less pronounced difference in lengths of the inner and outer dilations (Fig. 3d). In regard to the second character, after comparing over 140 males of *L. occidentalis* with 4 males of *L. corculus*, I found intraspecific variation in the shape of the posterior notch of the genital capsule in *L. occidentalis* to be at least as great as interspecific differences, thus rendering this character unreliable for separating the two species (also compare Figs. 46 and 47 in Allen 1969). Although I did not compare the shape of the male claspers of the two species (see Figs. 26 and 27 in Allen 1969), differences in shape may be consistent and important for species identification, but require careful dissection of the genitalia (Allen 1969). After spreading the wings of nine specimens of *L. corculus*, and comparing them with several dozen *L. occidentalis*, interspecific differences in the color pattern of the abdominal dorsum were so consistently and strikingly different, that it appears to provide a reliable and easy way of differentiating the two species (compare Fig. 3a with Figs. 3c and 3e). It is therefore surprising to me that Heidemann (1910), in his description of *L. occidentalis*, and Allen (1969), in his revision of the species of *Leptoglossus*, made no mention of the color pattern of the abdominal dorsum. The only reference I could find to this pattern in *L. occidentalis* adults was that of Koerber (1963): "The dorsal side of the abdomen is yellow or light orange with five transverse black patches," and "The adults are strong flyers and fly readily if disturbed. In flight the adults produce a loud buzz which, together with their size, manner of flight, and the orange and black pattern of the abdomen, is strongly suggestive of a bumble bee."

The striking orangish-yellow pattern on the abdominal dorsum of *L. occidentalis* (Fig. 3a is typical) includes the posterior margin of tergite 3; a trapezoidal-shaped area (widest anteriorly) covering the full lengths of tergites 4 and 5, interrupted medially by a black spindle or diamond-shaped marking that abruptly widens posteriorly to cover the postero-median projections of tergites 4 and 5; and a complete transverse band along the anterior one-third to one-half of tergite 6, this band shortened postero-medially by a dark, triangular projection of the posterior dark area of that tergite. The abdominal tergites of *L. corculus* (Fig. 3e is typical) are predominantly black, with small, indistinct, white or cream-colored markings antero-medially on tergite 4, and bordering the lateral portions of the postero-median projections of tergites 4 and 5. Fig. 3c illustrates the greatest development of these white or cream-colored markings in the nine specimens of *L. corculus* available to me, but this specimen was atypical. No sexual dimorphism in color pattern was evident in either species. It will be interesting to see if other workers find these differences in color pattern between *L. corculus* and *L. occidentalis* to hold up after examining a larger sample size of *L. corculus*, and also whether there may be distinctive differences in color pattern of the abdominal dorsum between other species of *Leptoglossus*.

The only drawback to use of this character is that it requires spreading specimens for complete visualization. Spreading is easy with fresh material, but first requires relaxing in the case of dried specimens. However, enough of the striking orangish-yellow color pattern of *L. occidentalis* can be visualized to permit identification by using forceps to slightly lift the postero-lateral margins of the folded wings of even dried specimens.

The key to species of *Leptoglossus* north of Mexico provided by McPherson et al. (1990) can be modified as follows:

8. Outer hind tibial dilation nearly equal in length to inner dilation; abdom-

inal tergites 4 and 5 with striking orangish-yellow markings, each interrupted medially by a black, spindle or diamond-shaped marking ..... *L. occidentalis* Heidemann

8'. Outer hind tibial dilation distinctly longer than inner tibial dilation; abdominal tergites entirely dark or nearly so, striking orangish-yellow markings absent ..... *L. corculus* (Say)

DISPERSAL

First records of *L. occidentalis* for southern Ontario (November, 1985) and western New York (January, 1990) provide conservative estimates for arrival times in these areas. McPherson et al. (1990) inferred that the pattern of eastward spread of *L. occidentalis* was associated with the ability of this species to utilize several native or introduced species of conifers in the east as food plants. In the last few decades, several of these conifers (particularly *Pinus nigra*) have been increasingly planted in the northeast in parks, on college campuses, along highways, and in landscaping commercial and residential properties. While collecting in the field, I have been impressed with the strong and rapid flight of *L. occidentalis*, as was Koerber (1963). Given the intrinsic dispersal capabilities of *L. occidentalis*, and its propensity to wander in search of overwintering sites, it is plausible that this bug has 'hop-scotched' east between the increasingly available islands or patches of host conifers. Its catholic feeding habits are also an advantage in dispersal, permitting it to shift to hosts with available cone crops. For example, published records for intervals between large seed crops are: 2–5 years for *Pinus nigra*, 3–7 years for *Pinus resinosa*, 3–10 years for *Pinus strobus*, and 4–6 years for *Pinus sylvestris* (USDA 1974).

Data for the two apparently disjunct northeastern records, in Connecticut and eastern Pennsylvania, suggest that human-mediated dispersal may supplement the direct dispersal of *L. occidentalis*. The lone Connecticut record is from a douglas fir Christmas tree in a house on 27 Dec. 1985. It seems doubtful that establishment of a bonafide population in Connecticut would have long escaped the notice of heteropterists James Slater, Carl Schaefer and their students at the University of Connecticut, Storrs. Yet as of March, 1991, no other specimens had been collected there (R.J. Packauskas, pers. comm.). Assuming the bug did indeed enter the Connecticut home on the Christmas tree, the interesting possibility arises that the eastward spread of *L. occidentalis* may be facilitated by the commercial Christmas tree trade from the western states. Michael Pochan, Secretary of the Connecticut Christmas Tree Growers Association, has advised me (pers. comm. 22 Feb. 1992) that douglas fir Christmas trees have unquestionably been trucked into Connecticut from Washington and Oregon for sale during the last 4–10 years. Alfred G. Wheeler, Jr. (pers. comm. 5 Feb. 1992) provided precise documentation for eastward commercial transport of *L. occidentalis*: a single male intercepted by the Pennsylvania Department of Agriculture at York, Pennsylvania, in a rail shipment of corn originating from Mendota, Illinois. These records provide compelling evidence that *L. occidentalis* is indiscriminate in its selection of overwintering sites, even opportunistically entering commercial loads, in which it can effectively hitchhike.

Figure 2 graphically illustrates the eastward expansion of the range of *L. occidentalis* over time. The chronology of some records may be artifacts of lack of collecting effort or lack of reporting to extension or university entomologists, e.g., years of first records for Washington, Oregon, and Wyoming. But in the relatively more populated central and eastern states and provinces,

where there is a higher probability of human-bug contacts (and probably a greater concentration of entomologists and extension agents to report such contacts to), the trends in records probably more closely reflect expansion of range. The habit of *L. occidentalis* coming into buildings for overwintering, and its large size and conspicuousness, facilitate its detection and hence awareness of newly established populations in an area (Marshall 1992, Shaffner 1967). Shaffner (1967) convincingly argues that 1956 is a reasonably reliable first record for Iowa, given the historic collecting effort by heteropterists at Iowa State University, Ames. He also presents a first record of 1961 for Indiana, based on a single specimen collected by a student, but there are no additional records for Indiana until 1980 (McPherson et al. 1990). Collection records suggest that *L. occidentalis* became established in Illinois and Wisconsin by the mid to late 1970's, in southern Michigan and southern Ontario by the mid-1980's, western New York by early 1990, and western Pennsylvania by 1991. Thus it appears that *L. occidentalis* provides one of the best documented cases of a native insect expanding its range eastward in North America [see McPherson et al. (1990) for examples of other Heteroptera].

It also appears that Van Duzee (1917) mistakenly substituted Idaho for Utah as a locality for *L. occidentalis*, an error perpetuated by Torre-Bueno (1941). Heidemann's (1910) male syntype was from Utah (chosen as lectotype by Allen 1969), and he did not report examining any specimens from Idaho in his description, while Van Duzee (1917) and Torre-Bueno (1941) list Idaho but not Utah as a locality for this coreid. The first bonafide record for Idaho appears to be that of Harris and Shull (1944).

Extension agents and pest control operators in New York, Ontario (Canada), and elsewhere in northeastern North America should be aware of the range extension of this coreid, and the potential for nuisance complaints from homeowners during autumn and winter. At the onset of cold weather in late summer and early autumn, *L. occidentalis* frequently congregates on the outside walls of buildings, especially south-facing exposures, where they seem to bask in the sun. The high incidence of individuals collected around or between windows and doors, suggests these to be a common point of entry; conversely, this bug may be attracted to the light at windows and doors seeking an exit from buildings. For example, Deborah Brassel carefully recorded the location of 12 *L. occidentalis* collected inside her Amherst, NY, home between 3-17 Dec. 1990. She found them in 7 different rooms on 2 floors, and 8 of the 12 specimens were found at windows. Elizabeth Gugino collected 12 specimens in her Orchard Park, NY, home between October and January in an estimated 7 rooms and the basement; she noted 4 specimens between a loose screen and window on one occasion. Where *L. occidentalis* is a persistent nuisance in homes, the best method of control therefore appears to be mechanical exclusion: weather-stripping or replacing loosely fitting screens, windows and doors; caulking gaps around door frames, window frames, and soffits; and tightly screening attic and wall vents. Consideration should also be given to appropriately screening fireplace chimneys, as one homeowner in the Town of Aurora, NY, collected several *L. occidentalis* on the floor near his fireplace before the heating season began. In December, 1991, a homeowner in Metropolitan Toronto, Ontario, also found one male *L. occidentalis* overwintering in a crevice of a piece of firewood that he brought inside from his wood pile. Whatever the point of entry into homes, nuisance complaints followed a pattern of this coreid becoming active and conspicuous on mild (often unseasonably mild) days when the ambient temperature rose above freezing from autumn to spring.

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