

NEW RECORDS OF MICHIGAN CICADIDAE (HOMOPTERA), WITH NOTES ON THE USE OF SONGS TO MONITOR RANGE CHANGES

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ABSTRACT

We present records of *Diceroprocta vitripennis*, *Tibicen chloromera*, and *Tibicen pruinosa* (new state record) in Michigan. Monitoring geographic range changes and population size differences by song suggests several population situations for cicadas: (1) sizable populations in most areas of apparently good habitat; (2) widely separated single individuals or small populations on the edges of populated regions, representing range extensions that may be of limited duration; (3) one or a few individuals present only once, probably transferred in soil on roots, and ultimately unsuccessful. Species-specific calling songs allow sensitive measurement of species' range changes.

A REVIEW OF SOME EXISTING RECORDS

Moore (1966) listed ten species of cicadas in Michigan. Alexander et al. (1972) doubted the significance of two of these species' records. First, the record of *Magicicada cassini* (Fisher) was based on a single specimen "found amid several quarts of specimens collected 21 June 1936 in Ann Arbor (Brood X) by I. J. Cantrall" (Moore 1966) at Eberwhite Woods in Ann Arbor, Washtenaw County. This specimen could not be relocated, and the species has not otherwise been reported in the vicinity of Ann Arbor, despite listening efforts (which have included Eberwhite Woods) during every emergence since 1957. These circumstances lead us to doubt that *M. cassini* exists in Michigan. Second, *Tibicen chloromera* (Walker) was reported from a specimen found in a student collection from Whitmore Lake, Washtenaw County, and labeled as taken dead inside an automobile; TEM also reported this species from Lenawee and Ingham Counties. Alexander et al. (1972) suggested that *T. chloromera* may not occur in eastern Michigan north of Lenawee County. Between 1957 and 1993, no songs of this species were heard in southeastern Michigan by either TEM or RDA. Our new records, including *Tibicen pruinosa* Say, a new state record, return the number of cicada species known in Michigan to ten: *Diceroprocta vitripennis* (Say), *Magicicada septendecim* (L.), *Okanagana canadensis* (Prov.), *O. rimosa* (Say), *Tibicen auletes* (Ger.), *T. canicularis* (Harris), *T. chloromera*, *T. linnei* (S. and G.), *T. lyricen* (De G.), and *T. pruinosa*.

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NEW RECORDS

Our records are composed primarily of listening records. In 1993, 1995, and 1996, intensive efforts were made to seek out and listen for the cicada species listed below. We did not make any special efforts to listen for these species during 1994.

***Diceroprocta vitripennis* (Say)** – Moore's (1966) Michigan record of *D. vitripennis* has been supplemented by (1) the collection of four females and one male at Warren Dunes, Berrien County, on 17 July 1982, by Mark and Adrienne O'Brien, (2) a single female collected in Grand Mere, Berrien County, 21 July 1982, by L. Schaddelee (Univ. Mich. Mus. Zool.), and (3) a single male collected at Grand Mere by D. Wilsey on 20-24 June 1996 (deposited in UMMZ).

***Tibicen chloromera* (Walker)** – On 30 August 1993, RDA heard one male of *T. chloromera* singing in Jasper, Michigan (Lenawee County), on Route 52, and several others along Black Creek, approximately 0.7 mi. south of Jasper. DCM confirmed these records on 21 August 1996 and added an additional listening record (several males) along the River Raisin, on Deerfield Road east of Adrian in Lenawee County. TEM noted *T. chloromera* in this county in 1995 and 1996. On the afternoon of 5 September 1996, DCM and JRC heard several males of *T. chloromera* in St. Joseph County, along the Pigeon River at the intersection of Marl Lake Road and Indian Prairie Road and along the Fawn River at Sevinson Road. Additional listening by DCM and JRC on these days in Hillsdale, Branch, Cass, and Berrien Counties yielded no *T. chloromera*. However, TEM reports having heard this species in Hillsdale County and recorded it in Monroe County (1994, 1995 and 1996) north of Dundee near the Raisin River, on Davis Rd. *T. chloromera* is abundant across much of the eastern United States, including most of Ohio, and it now appears to extend into the southern tier of Michigan counties. All of our records are limited to the southern portions of these counties, despite listening efforts farther north. Moore's (1966) record from Ingham County stands alone in this respect; new listening attempts should be made to determine if the species persists there.

***Tibicen pruinosa* Say** – On 23 August 1993, at approximately 20:00 hr, DCM heard one male of *T. pruinosa* singing on Packard Street at Arch Street in Ann Arbor, Washtenaw County. On 26 August 1993, at approximately 20:25 hr, DCM tape-recorded a male of *T. pruinosa* singing at the corner of Geddes Avenue and Church Street, in Ann Arbor. On 18 August 1995, at 20:42 hr, DCM recorded another male at this same location. On approximately the same date, RDA heard either one or two *T. pruinosa* males singing at Bethel Church Road, 0.3 mi. west of Schneider Road, Washtenaw County; the cicadas were heard on two days only. Although RDA had lived on a farm at this location for 21 years, he had never heard *T. pruinosa* there before, and he did not hear it again in 1996. On 18 August 1996, RDA heard single males of *T. pruinosa* in Jasper, Lenawee County, and 4.5 mi. south of Jasper on Route 52. On 21 August 1996, DCM heard one or two *T. pruinosa* at the intersection of Carson Highway and Shepherd Road north of Adrian, in Lenawee County. Louanne Reich, of the UMMZ, heard a single male *T. pruinosa* singing in an elm next to the Kraus Natural Science Building, on the University of Michigan campus, at dusk on 6 September 1996. TEM reports listening records of *T. pruinosa* in Branch, Hillsdale, and Lenawee Counties in 1959. Like *T. chloromera*, *T. pruinosa* occurs across much of the eastern United States, including most of Ohio, north to the Maumee River drainage in the northwestern part of the state.

Figure 1 illustrates the existing Michigan records of the three species



Figure 1. Michigan records of *Tibicen chloromera* (open circles), *Tibicen pruinosa* (filled circles), and *Diceroprocta vitripennis* (filled squares). Half-filled circle indicates both *Tibicen* species present. All *Tibicen* records are listening records. See text for descriptions of localities. Moore's records for Ingham, Branch, and Hillsdale Counties do not refer to specific locations.

discussed above. The songs and morphology of all the above species are distinguished in Alexander et al. (1972) and Alexander (1997). Voucher tapes of song records, where available, will be deposited in the UMMZ.

DISCUSSION

Interpretation of new records – Spotty year-to-year records, such as those described above, are difficult to interpret, especially when only small

numbers of animals are observed and when the records are found near the edge of the species' known range. This situation is exacerbated by the high mobility and prolonged development of insects such as cicadas (from 2-17 years, see Karban 1986). Four possible situations may exist with regard to a species' distribution: (1) A species may be absent from a location; (2) one or more individuals may be spotted in a location in only one year, and not appear in subsequent years; (3) one or more individuals may be spotted in more than one year, but not in other years (and the records may or may not exhibit periodicity, as in periodical cicadas); or (4) the species may be present every year. For cicadas, situations #2 and #3 could indicate (A) the existence of sustaining populations of cicadas in one or more different year-classes (in the case of #2, cicadas with a long life cycle), (B) the occasional appearance of migrants who fail to reproduce successfully, (C) the occasional maturation of imported nymphs who fail to reproduce (see Chilcote and Stehr [1984], for an example of importation via transplanted trees), or several of these alternatives at once. Even situation #4 could result from repeated immigration of a highly mobile species or from an ongoing range extension, especially if the numbers observed are small. Periodical cicadas, with their long life cycles and known history of life-cycle-length plasticity (straggling), introduce an almost perverse degree of difficulty to this problem (Marshall, ms. in prep). Generally, these difficulties will be reduced when mobility is low and accidental importation unlikely, and when the life cycles involved are not longer than one year. In no situation, however, can a single positive record be used with confidence to extend the known range of a species. Rarity and difficulty of observing or collecting confound any study of distribution or abundance; incomplete understanding of a species' natural history magnifies this problem, because even a diligent observer might fail to locate a species by searching in a slightly inappropriate microhabitat (but see below on advantages of song records). Apparent rarity or absence, then, must be interpreted with caution.

Because the new localities given for *Tibicen chloromera* are found very near to known populations in Ohio, and because often several males were heard at once, it appears to us that *T. chloromera* is established in some of the southern Michigan counties. Either *T. chloromera* has been established for some time in these areas and missed by previous surveys, or this species is extending its range. We probably can apply the same interpretation to the records of *T. pruinosa* in the southern tier of Michigan counties. In contrast, the observations in multiple years of (usually) single individuals of *T. pruinosa* in Washtenaw County, 40-50 miles beyond their known range limits along the Michigan-Ohio border, are more difficult to understand, and range extension from adjacent populations may not be the best explanation. Chilcote and Stehr (1984) described the emergence in 1982 of a new population of Brood V of *Magicicada septendecim* on the campus of Michigan State University in East Lansing, Ingham County, hundreds of miles beyond the known range of this brood. These cicadas had apparently been introduced several years earlier as nymphs in the soil of transplanted dogwoods. A similar process might account for our observations of *T. pruinosa* males in Washtenaw County, although one would probably have to assume multiple importations to explain the records from different localities. (Records from multiple years do not necessarily indicate the presence of a breeding population, because life cycle plasticity might cause juvenile cicadas from a single introduced population to emerge over several years, especially when they are transplanted beyond their natural range.) Unless we invoke either multiple introductions or recurring dispersal over large distances, we are left with the unlikely possibility that *T. pruinosa* is established in Washtenaw County at

such low densities that no more than one or two are heard each year. Thus, the records discussed in this paper may represent two different situations: (1) small, introduced populations that may or may not persist (*M. septendecim* and possibly *T. pruinosa*), or (2) an ongoing range extension (*T. chloromera* and possibly *T. pruinosa*).

The significance of song records - Species with long-range, species-specific acoustic signals, such as those of the singing Orthoptera and Cicadidae, provide an opportunity for study matched by few other kinds of organisms (most notably anurans and some birds). Males of these species reliably broadcast their identity and location over great distances for weeks or months each season. Single calling individuals can be located with ease by trained observers, even without detailed knowledge of the species' preferred habitat. Therefore, listening for the presence or absence of calling songs in an area is a highly sensitive means of data collection, making species with such signals ideal subjects for analyses of speciation, hybrid zones, character displacement, dispersal, or any study in which detailed and extensive knowledge of distribution or abundance is required. Systematic observations over time can reveal even minor fluctuations in a species' range. With the ability to locate easily the first immigrants in a locale, one can measure dispersal tendencies and rates of range extension. The primary drawback of sound records is the ephemeral nature of the record itself. We recommend making voucher recordings whenever possible.

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