

New northern records of *Tibicen chloromera* (Hemiptera:Cicadidae) in Connecticut

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ABSTRACT

We present new records of *Tibicen chloromera* (Walker) in Connecticut. Monitoring population size differences by song suggests that several population densities are common in *Tibicen chloromera*: (1) sizable calling populations (2) small populations numbering no more than 5 calling individuals (3) single calling individuals that often do not remain in the same location for more than a few days. We discuss the distribution of this species in the state and the implications of differing densities.

BACKGROUND AND REVIEW OF EXISTING RECORDS

Tibicen chloromera (Walker), is a large, dark cicada common in parts of the eastern United States. Members of this species have a preference for moist soils or areas near water and are sometimes referred to as "swamp cicadas" or "swamp ground cicadas" (see Davis 1926; Froeschner 1952). Some literature suggests that the abundance of this species varies from year to year (e.g., Beamer 1929), while other sources suggest that *T. chloromera* is one of the more reliably abundant species in this genus (e.g., McAtee 1927). *Tibicen chloromera* are readily separated from most other *Tibicen* in Connecticut by several morphological features. Unlike *Tibicen lyricen* (DeGeer), *T. canicularis* (Harris), and *T. linnei* (Smith and Grossbeck), *T. chloromera* lack a dark, median band on the underside of the abdomen. The opercula of *T. chloromera* are also unusually long, (≥ 10 mm (Beamer 1929; Davis 1926), the eyes are less prominent than in other Connecticut *Tibicen*, and the pronotal collar is usually black although some specimens exhibit an irregular olive green spot near each humeral angle, especially in females. The call of *T. chloromera* males is distinctive and is sometimes used in horror movies as a sound effect to augment a sense of impending danger. Few detailed records of *T. chloromera* in Connecticut exist. W. T. Davis (1923) suggested that *T. chloromera* was generally a southern species and that it was uncommon in Connecticut. He noted records in Greenwich and Stamford, and suggested that this species had a northern range limit in Fairfield County.

METHODS

Adult *T. chloromera* are active from early July to early September (Beamer 1929; Froeschner 1952; McAtee 1927). This species has a distinct and unmistakable call, so that it is easy to identify by ear. Our records are composed of listening records, specimen records, audio and video recordings collected during a series of short car trips in 2005-2007. We relied primarily on sound records to establish the presence of this species and to estimate the number of calling males present (this method does not detect females). Since weather conditions influence male calling behavior, we collected data only on bright, warm days with temperatures above 70°F. *Tibicen chloromera* call more reliably in the morning hours (Beamer 1929), so we listened between the hours of 8:30 AM to 12:30 PM. We collected both positive (presence) and negative (absence) records by driving to wooded areas along watercourses and listening at least 5-10 minutes to confirm positive records and 15-20 minutes to establish negative records. To confirm that we were searching during appropriate calling conditions, in most collecting trips, we used known positive records as our starting point, and during each trip, we tried to revisit known positive records to verify that conditions remained appropriate for searching. Within practical limits, we intended our search to be as exhaustive as possible.

We estimated population densities by listening and counting the number of males calling. Since estimates are likely to be more accurate for small rather than large populations, we used the following criteria (see Marshall et al. 1996) to categorize our observations: (1) A species may be absent from a location; (2) A high density (≥ 5) population may be present in an area; (3) A low density ($1 < x < 5$) populations may be present in an area; or (4) a single individual may be calling in an area.

We used a handheld GPS system (Garmin, e-trex) to find the latitude and longitude of all localities surveyed. We also collected voucher specimens and sound recordings using a digital recorder (Marantz PMD 680), a video camera (Sony Handycam Vision Video Hi8) or a digital camera (Mustek 5.0)

NEW RECORDS

Figure 1 summarizes our observations of *T. chloromera*. Our new records indicate that *Tibicen chloromera* populations may be found as far north as Suffield, Connecticut (Hartford County), and that individual calling males also occur in mainland Massachusetts, Martha's Vineyard, and Nantucket. Most records outside the Connecticut River Valley consist of one or two calling males; denser populations were found within the river valley. *T. chloromera* seemed to call most commonly in the Connecticut River valley in the morning, while outside the valley, they were more commonly heard calling midday. Detailed record and location descriptions are deposited in Cicada Central (<http://hydrodictyon.eeb.uconn.edu/projects/cicada/Databases/cicadabase/cicadatitle/cicadasearch.php>).

DISCUSSION

Most of our *T. chloromera* records are from swampy areas, or areas that are near rivers or floodplains. Silver maple (*Acer saccharinum*) was abundant at many of our sampling locations, supporting earlier indications that *T. chloromera* has some association with wet soils. We found that contrary to earlier reports, the northern range limit of *T. chloromera* in CT is nearly the CT/MA border; our observation of calling males on Blossom Street, Suffield, was only 1.25 miles south of the MA border. Although we did not find any *T. chloromera* in MA near Suffield, the North Chelmsford and Cambridge, MA records demonstrate that *T. chloromera* can be found farther north than the CT/MA border.

The densest population we observed was in Wethersfield, CT behind Wethersfield High School; this population appears to be well-established, since it has been reliably present in multiple years. When we listened to this large population, at times there was combined sound that could almost be described as a chorus. All the calls started to blend together and it was difficult to discern when one song started and another ended. As with other cicada choruses (e.g., *Magicicada* spp. and *Okanagana rimosa*), the continuous sound made it difficult to localize individual calling males. We do not know if there were competitive interactions leading to synchronized chorusing (e.g. Greenfield and Roizen 1998), or whether male behaviors are different in high population densities, but these questions should be the subjects of future studies once additional dense populations are located.

Most of our records are of much smaller populations in which densities appeared to change over time; for example, we heard a single individual calling on Blossom Street, Suffield CT on several occasions in 2005 and early 2006, but we did not hear this individual on visits later in 2006, suggesting that the population may be small or poorly-established. Others, such as the Coventry CT record, are of single individuals that were heard in the same general area over the course of several days. Uncertainties concerning changes in *T. chloromera* abundance over the course of a single season or over the course of multiple seasons complicates any understanding of these populations. Although these records may not represent permanent populations, future investigation may reveal a permanent source population nearby, and may help clarify whether such "satellite males" are emigrants peripheral to a nearby, dense source population.

Our data differ substantially from Davis' published records (1923), reporting *T. chloromera* as uncommon in CT with a northern limit of Greenwich in Fairfield County. Two hypotheses account for this discrepancy: Either 1) *T. chloromera* has expanded its range since the time of Davis' records (1892) or (2) earlier positive records may not have been intended to be exhaustive and negative records may have been taken at inappropriate times or under inappropriate conditions. If Davis' records are accurate, and if *T. chloromera* is moving north, the Connecticut River may play a role in this movement. Higher densities near the river suggest that *T. chloromera* may have followed the river north towards Massachusetts. While the river may facilitate northward spread, it may hinder eastward spread; GJB noted that while standing on the eastern side of the Connecticut River in Windsor Connecticut on South Water Street, he could hear *Tibicen chloromera* calling directly across the river on the western bank while none could be heard where he stood on the eastern bank, suggesting that *T. chloromera* is

unlikely to cross wide water barriers. Although most of our observations were made in towns located near the Connecticut River, we did notice a decrease in *T. chloromera* density as we moved away from the river; east of the river and its floodplain, all our records consist of single individuals or extremely low density populations. It seems unlikely that range expansion outward from the Connecticut River could explain the records in Litchfield County, CT and Dutchess County, NY, since high ground appears to separate them from other populations.

In spite of our efforts, we have not found populations linking the Massachusetts and Connecticut records or linking offshore Massachusetts records to the mainland. One possible explanation is that *T. chloromera* may have been transported into Massachusetts by humans. Other examples of human transportation of cicadas have been published; periodical cicadas (*Magicicada spp.*) may have been introduced to East Lansing, Michigan by humans (Chilcote and Stehr 1984), and humans may also have transported cicadas between New Zealand's North and South Islands (Hill et al. 2005). Our Martha's Vineyard record of *T. chloromera*, near a tree nursery, is especially suggestive of human transport; if it is true that bodies of water are barriers to the spread of this species, then an alternative explanation for their presence on the island is that they arrived on nursery stock.

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Figure 1. A map of new records of *Tibicen chloromera* in Massachusetts and Connecticut. Darker circles indicate denser populations. Detailed records may be found online at: <http://hydrodietyon.eeb.uconn.edu/projects/cicada/>