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C O N T E N T S

ARTICLES

BROOD II OF THE 17-YEAR CICADA ON STATEN ISLAND:
TIMING AND DISTRIBUTION

Chris Simon

ADDITIONS TO THE BREEDING BIRD LIST, 1978

Norma and William Siebenheller

SPECIAL REPORT

THE POND SURVEY, Staten Island, New York, 1975-1976.
Part VI.

Albert J. Hendricks, Ph.D., and Hans Behm, M.S.

COMMUNICATIONS

ANNUAL BIRD COUNTS: Christmas Bird Count, 1978 and
Waterbird Count, 1979. Richard Zaineldeen
Big Day Bird Count, 1979. Norma and William Siebenheller

BOOK REVIEW

Mineral Names . . . Richard Scott Mitchell. Reviewed by
Mildred Bradley

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Brood II of the 17-year Cicada on Staten Island: Timing and Distribution

by Chris Simon

Department of Ecology and Evolution
S.U.N.Y. Stony Brook
&
Department of Biology
University of Chicago

The coming of the 17-year cicada (*Magicicada*) is a more celebrated event on Staten Island than elsewhere largely due to the efforts of "one" William T. Davis. Following his death in 1945, his tradition of public education and record-keeping was carried on by his friends and colleagues at the Staten Island Institute of Arts and Sciences. This paper summarizes the distribution and timing of the 1979 emergence of Brood II of the periodical cicada on Staten Island and incorporates the Institute's records for 1894, 1911, 1928, 1945, and 1962. A comparison of these records will provide the most complete summary of variation in timing of *Magicicada* life history events yet available.

THE THREE SPECIES

There are three species of 17-year cicadas all of which are found on Staten Island: *Magicicada septendecim*, *M. cassini*, and *M. septendecula*. *M. septendecula* was not described until 1962 (Alexander and Moore, 1962) because of its similarity to *M. cassini*. Both of these are smaller than the more common *M. septendecim* and the courtship song of *cassini* is similar to the chorusing song of *septendecula*. The three species can be distinguished in the field. *M. septendecim* has orange abdominal sternites (with occasional black markings along the midline and anterior sternite borders), black tarsi, and an orange patch behind and below the eye. The smaller *M. cassini* has entirely black abdominal sternites, black tarsi, and no orange patch. *M. septendecula*, similar in size to *M. cassini*, has orange-striped abdominal sternites, orange tarsi and no orange patch. The chorusing song of each species is quite distinct (Alexander and Moore, 1962).

The three morphologically distinct species also differ in microhabitat preference. *M. cassini* prefers floodplain forests. The other two are typically found in the uplands where *septendecula* exhibits a strong preference for hickory trees (Lloyd and Dybas, 1966, Dybas and Lloyd, 1974). In disturbed situations these preferences tend to break down (Lloyd and White, 1976).

LIFE HISTORY

Periodical cicadas emerge earlier than most of their annual relatives: mid to late May, rather than July or August. Fifth instar nymphs emerge in the evenings over a week's time. The heaviest emergence is usually concentrated in one or two nights. The males begin to sing two days to a week after emergence depending on the population density (Rick Karban, personal communication). Mating takes place in the second or third week and is followed immediately by egg laying. Eggs are laid in slits in pencil-sized tree branches: an average of 24 eggs/nest (Marlatt, 1907). Excessive oviposition damage can result in the death of twigs and consequently little or no hatching (White, in prep.). The dead brown branch tips (called flags) stand out in contrast to the green leaves and can be used to map the distribution of the cicadas after the adults have died.

The adults live four to six weeks. The eggs hatch one and one-half to two months after they are laid and the millimeter-long larvae fall to the ground, crawl into cracks in the soil (Snodgrass, 1921), and begin to feed on the xylem fluid of tree rootlets (White and Sthrel, 1978).

BROODS

Periodical cicadas are found only east of the Great Plains in the United States. The year of adult emergence differs from place to place. Each year-class is called a brood. The broods are numbered sequentially: Brood I last emerged in 1978, Brood II this spring (1979), Brood III next year, etc. Broods which overlap geographically are separated in time by at least four years while adjacent broods are often separated by only a year (Alexander and Moore, 1962; Lloyd and Dybas, 1966). Most broods contain all three species. At present there are thirteen broods of 17-year cicadas. In general, most broods have geographic and evolutionary continuity (Simon, 1979a), although disjunct populations are known to exist (Simon, Karban and Lloyd, in preparation).

1979 FIELD SEASON

Brood II of the 17-year cicadas emerged this spring in northern Georgia (Hudgins, 1979; Anonymous, 1979), North Carolina, Virginia, Pennsylvania, Maryland, New Jersey, New York, and Connecticut (Figure 1). A field assistant and I traveled throughout the range collecting specimens (for morphological and allozymic studies), and mapping the distribution. Special attention was paid to Staten Island because records on timing and distribution have been kept every generation since 1894 (Davis, 1911; Koestner, 1945; Cleaves, 1946; Abbott, 1949).

We made several trips around Staten Island during the field season and two flagging surveys after the adults had died. In addition, a re-

quest for information was printed in two semi-popular magazines (Simon, 1979b; 1979c), and records were solicited by Joseph F. Burke of the Staten Island Museum.

Distributional information is summarized in Figure 2. The stippled portion represents the edges of the distribution as determined from the flagging surveys. There were several areas noted where oviposition was not heavy enough to cause damage. These areas are indicated by hollow stars. Other areas in the southeast may have had cicadas but no records yet exist. Other symbols are discussed later in the text.

Although the map of Figure 2 shows the cicadas' distribution as essentially continuous, their populations were, as they typically are, patchy. The patchiness increases near the edges of the stippled portion. The smallest disjunct stippled dot (Wheeler Ave.) is an example of this situation. Cicadas were very heavy on this block and light or absent on surrounding blocks. No explanation for this phenomenon has been forthcoming but it has been documented on a microspatial scale as well (Simon, Karban, and Lloyd, in prep.).

CHANGES IN DISTRIBUTION

Because travel was more difficult in 1894, 1922, and 1928, Davis made no surveys of the entire island's cicada populations. He made most of his journeys on foot. Specific locations noted by Davis are listed in the appendix.

The most significant change in the distribution of the periodical cicadas on Staten Island is one of which Davis noticed the beginnings:

"While the cicadas were generally distributed over the wooded portions of Staten Island except the small so-called pine barren areas, yet, as has been observed in previous years, they were much more numerous in some places than in others. In 1877 there were a great many seventeen-year cicadas in the garden at New Brighton surrounding the house where I lived. Though the same fruit trees are standing and the conditions as regards vegetation have not particularly changed, yet I failed to find any of the cicadas in 1911. Probably they have been exterminated by the house-sparrow." (In Abbott, 1949, p. 165)

Thus, by 1911, periodical cicadas were beginning to disappear from the north end of the island. Joseph F. Burke heard two *Magicicada* singing in Davis' old neighborhood in 1962 but saw none.

In West New Brighton, cicadas were plentiful in 1928, 1945, and 1962, but in 1979 only a few individuals were seen and no damage was apparent in the trees. Only a few thousand individuals were noted to emerge in the vicinity of the Staten Island Zoo where extremely heavy populations had been present in 1962. As a result, singing was noted to begin late in the season and end earlier than other places and no oviposition damage was seen (E. Oppenheimer, personal communication). J. Rawson of Pelton Ave., West New Brighton, saw only three live adults and 40 to 50 exit holes this year, whereas Koestner (1946)

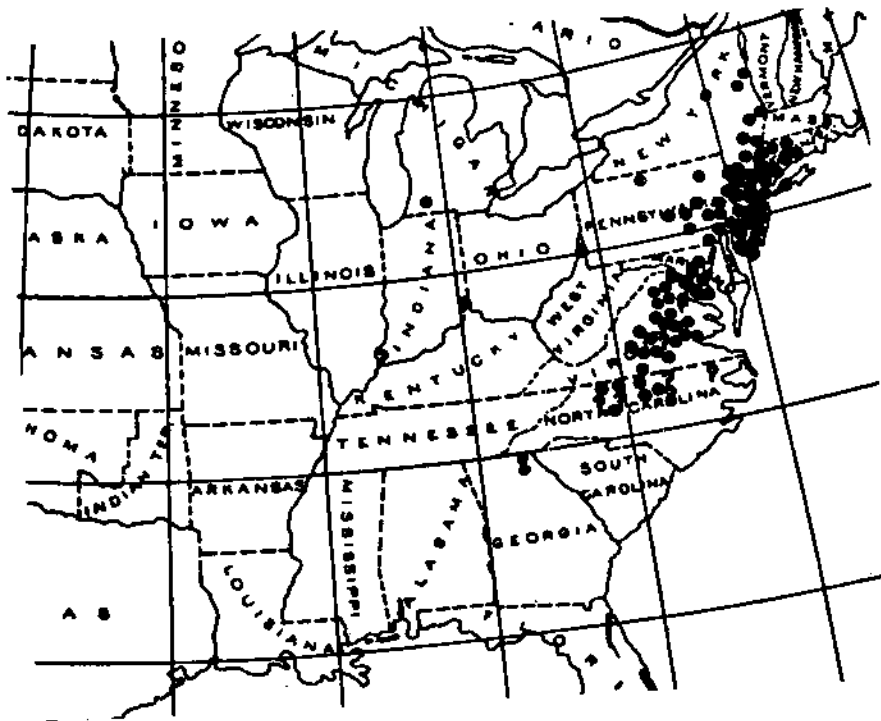


Fig. 1
Map of the distribution of Brood II (modified from Marlatt, 1907).

reported heavy populations on Pelton Ave. in 1945. On nearby Valencia Ave., Dr. R.J. O'Connor reported that periodical cicadas were abundant in 1962 and absent this year.

The entire north and east end of the island seems to have experienced a decline. H. Behm, formerly of Stapleton, reports that the cicadas were heavy all along Howard Ave. in 1962. This year, there were no oviposition scars to be seen along Howard Avenue except at the extreme southern end near Wagner College and Sunnyside. Similarly, cicadas were reported as heavy at 960 Fingerboard Road in 1928 and 1945, yet no oviposition damage was seen in 1979 at the same address.

The Clove Valley was one of Davis' favorite spots for observing 17-year cicadas. He described the emergence as heavy in 1928 at Britton's Upper Pond. This year there was considerable oviposition damage to the trees at the extreme southern end of the park; however, the only evidence of their appearance in the northern end of the park was two or three trees with a few brown branch tips at the eastern end of Martlings Pond (E. Oppenheimer, personal communication).

In 1928, Davis noted that the periodical cicadas "are not as plentiful about Tottenville as on some of the hills near the middle of the island." In 1979, the *Magicicada* populations seem to be increasing in some parts of the southern half of the island, for the heaviest emergence

areas were Annadale, Huguenot, and Tottenville. However, T. Weber wrote in 1979, "This time they were not as numerous as then [1962] for we have experienced a lot of building around us [Great Kills]."

TIMING

The mechanism by which *Magicicada* spp. sense the passing of exactly 17 years is unknown. Nymphs do not all grow at the same rate (White and Lloyd, 1975). This may be due to differences in nutrition.

The cue which marks the beginning of an emergence is better understood. Heath (1967) has shown experimentally in the field that ground temperature has an influence. Reports of cicadas emerging early in cleared areas or under greenhouses (Marlatt, 1907) support his findings.

In 1979, the spring weather was unusually rainy and cool in the northeast. An exceptional heat wave, May 8-11, did not bring the cicadas out en masse even though holes, mud turrets, or occasional nymphs had been seen since the early part of April.

Large numbers of adults began emerging May 17 (High Rock Park) through May 21 (Annadale and Lighthouse Hill). The cool wet weather extended the emergence until June 5 in some areas (e.g., Richmondtown and Lighthouse Hill).

The cool weather also delayed the onset of chorusing but by May 31 all three species were singing loudly. *M. septendecim* was as usual the most common species. *M. cassini* was found in numbers in three places (marked by solid black dots on Figure 2): the corner of Huguenot and Arthur Kill Road, Arden Heights; Barclay Ave., Annadale; and at the corner of Harold Ave. and Kinghorn St., Annadale. *M. septendecim* was also present at each of the above localities. *M. septendecula* was found only at Buck's Hollow in the Greenbelt. It was very abundant on a cut-over hillside and in tall near-by Hickory trees. As always, *M. septendecim* was also present. The two smaller species may have occurred in other areas of the island but no extensive search was made for them.

Davis unknowingly lumped *cassini* and *septendecula* and called both *cassini*, "the dwarf form of the periodical cicada." The difference in coloration was at that time attributed to individual variation. He reported the dwarf form from four places: Willow Brook, Westerleigh, West New Brighton, and Rossville (marked by solid triangles on Figure 2).

This year, mating was observed May 31 (Buck's Hollow), June 1 (Wheeler Ave., Castleton Corners); June 10 (Kinghorn St., Annadale), and June 11 (Labau Ave., Sunnyside). Egg laying followed several days later. By June 21, the cicadas were on the decline and by the 1st of July, only a few were left singing.



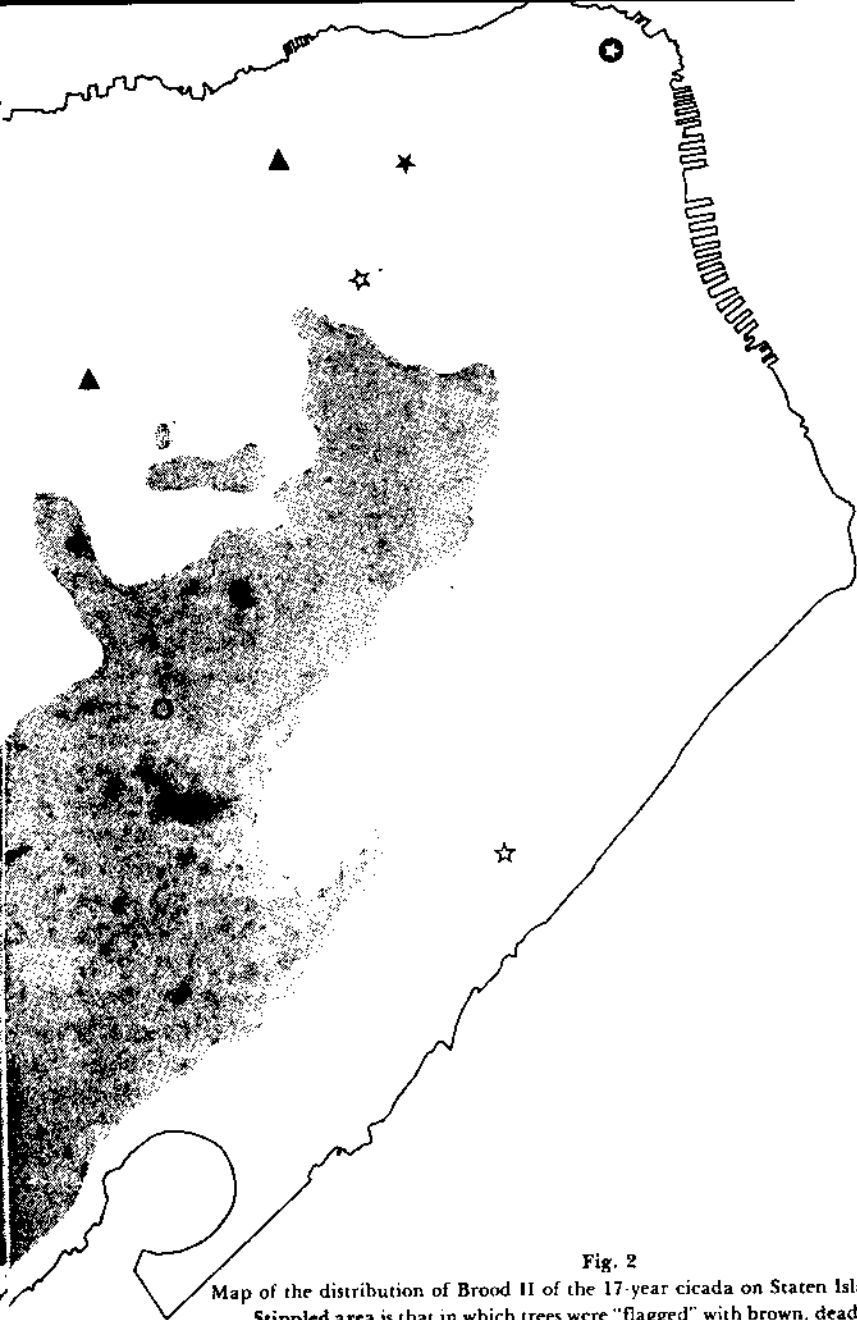


Fig. 2

Map of the distribution of Brood II of the 17-year cicada on Staten Island.

Stippled area is that in which trees were "flagged" with brown, dead leaves as a result of the oviposition damage caused by the periodical cicada.

Solid black circles indicate localities where *cassini* was found in 1979.

Solid black triangles show where Davis found the "dwarf form of the periodical cicada."

Hollow circles indicate where *septendecula* was found in 1979.

Hollow stars represent two localities reporting 17-year cicadas this year outside the flagging zone.

Black bullet with hollow star marks the location of the Staten Island Institute of Arts and Sciences and the area where cicadas were abundant in 1877 and absent (except for a few individuals), in subsequent years.

Figure 3 presents a summary table of the timing of the 17-year cicadas on Staten Island over six generations and some comparative data from other areas of the distribution. Records collected this year are printed below:

April 8	Holes and nymphs, Buck's Hollow.
April 29	Many nymphs above ground, Douglas Rd, Emerson Hill.
May 1	Nymphs seen under boards, Douglas Rd., Emerson Hill.
May 6	Nymphs above ground and turrets 11-12/sq. ft., Wolf's Pond Park.
May 7, 8	Many holes, and nymphs climbing trees, no locality.
May 9	Holes seen on Arthur Kill Rd. between Yetman and Lee Aves. and in the woods in the Tottenville area near Main St. and Amboy Rd.
May 10	Holes and turrets seen at Richmond Hill Rd. near Rockland Ave. and at Great Kills; Beech Rd. near Eltingville.
May 12, 13, 14	Foggy rainy cool weather. Temperature supposed to reach 70° F tomorrow.
May 17	Cicada adults begin emerging at High Rock Park. Egbertville.
May 19	Adults begin emerging at Oak Ave., Oakwood.
May 20	Adults seen on King St., Great Kills. No song yet.
May 21	A few live adults reported in the morning at St. George Rd., Lighthouse Hill and Harold Ave. and Kinghorn St, Annadale. The evening of the 21st many adults emerged at the latter address. Adults seen but no song heard yet. Lincoln and Greeley Aves., Midland Beach.
May 22	First cicadas seen on Helena Rd. and emergence continues on Lighthouse Hill and in Annadale.
May 23	Emergence continues on Lighthouse Hill and in Annadale. Several hundred holes located in empty lot corner of Brookfield and Genesee Aves., Great Kills.
May 24	Heavy rain, foggy and overcast.
May 25	Nymphs and adults found in various stages of emergence, Burbank Ave. and Clawson St., New Dorp.
May 27	Two or three adults and about a dozen holes seen in the garden of the Tibetan Museum, Lighthouse Hill.
May 31	Loud <i>septendecim</i> and <i>septendecula</i> choruses, Buck's Hollow. Loud <i>septendecim</i> choruses Wheeler Ave., Castleton Corners and at High Rock Park. Newly emerged adults still easy to find.
June 1	Loud <i>cassini</i> chorus heard at Arthur Kill Road and Huguenot Avenue. Both <i>cassini</i> and <i>septendecim</i> still

- emerging. Mating seen, Claypit Road. Hazy and warm, high about 80° F.
- June 5 Emergence on Clarke Avenue, Richmondtown (day) and continues on Lighthouse Hill (night).
- June 9 Loud chorusing; many dead cicadas on ground, Kinghorn Street, Annadale.
- June 10 Cicada mating in Annadale, Kinghorn Street.
- June 11 Hundreds dead, dying, and mating on Labau Avenue, off Victory Boulevard, Sunnyside. Rain.
- June 13 Cicadas abundant at Bunker Pond.
- June 14-18 Cicadas extremely abundant and active in Annadale. Egg-laying noted.
- June 19 Numbers somewhat less on Lighthouse Hill.
- June 21 On the decline, Lighthouse Hill; many dead and dying.
- June 23 Live as well as dead cicadas. Loud chorusing. Egg laying. LaTourette.
- June 26 Still a few cicadas singing, Lighthouse Hill.
- June 29 Not too many left, mostly *cassini*, Annadale.
- July 1 No live cicadas but many dead branches, Clay Pit Ponds State Park and Preserve.

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APPENDIX

The following is a summary of localities where cicadas were observed in previous generations. These locations are taken mostly from the notes of W. T. Davis, John Koestner (1945), and Joseph F. Burke.

1894 Old Place Meadow; Willow Brook; Moravian Cemetery; Clinton Avenue; Todt Hill; one-quarter mile from Watchogue Beach; Clove Road in West New Brighton; in the woods near Oakwood Beach.

1911 The Leng home on Clove Road; Great Kills; Richmond.

1928 In the woods west of Richmond; Todt Hill; in the Clove Valley on a hill near Housman's Cave; in the Clove Valley at Britton's Upper Pond; 960 Fingerboard Road; Great Kills; Watchogue; Page Avenue.

1945 960 Fingerboard Road; 81 Acacia Avenue in Great Kills; 154 Detroit Avenue in Annadale; Grymes and Emerson Hills; Richmond Avenue in Eltingville; 755 Pelton Avenue in West Brighton; 218 Potter Avenue; Wagner College; corner of Schmidt's Lane and Manor Road; Ellicott Place.

1962 Castleton Corners between 41 Reon Avenue and Todt Hill Road; Vroom's field (now North Gannon Avenue); 392 St. George Road between Lighthouse Avenue and Aultman Avenue; 173 Bidwell Avenue near Springfield Avenue; 714 Bard Avenue near Mathews' Avenue; Staten Island Zoo; Benziger Avenue between Bismarck and Westervelt Avenues; on the eastern side of Edgewood Road in Great Kills; 151 Fiske Avenue near College and Jewett Avenues; Hylan Boulevard from Hales Avenue to the Woods of Arden Road; corner of Richmond and Augusta Avenues in Eltingville; Irvington Street and Chester Avenue; 6215 Amboy Road in Pleasant Plains near Goff Avenue and Bloomingdale Road; 33 Valencia Avenue near Randall Avenue; Clove Lake Park; W. T. Davis Wildlife Refuge; 146 Stuyvesant Place near Hyatt Street; S. I. Museum building, Stuyvesant Place and Wall Street; and from Great Kills to Annadale.