

**Observations on Periodical Cicadas (Brood X) in Indiana
in 1987 (Homoptera: Cicadidae)**

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Abstract

Periodical cicadas of Brood X (*Magicicada septendecim*, *cassini*, and *septendecula*) emerged in large numbers in three large areas in the eastern United States. The nymphal emergence holes and turrets similar to those of crawfish were observed in early May, and emergence of adults occurred shortly afterwards in forested areas east of Bloomington in Indiana. The first adults emerged on the Indiana University campus on the night of May 12-13. The largest emergence occurred between May 17 through the 29th. The last observed emergences occurred during the morning of June 4. The response to a computerized solicitation of records from Indiana and Ohio county agricultural agents made by the junior author indicated a very extensive emergence in those states. Records from the northern tiers of counties in both states are the first since the early part of the century. Cicadas (presumably of Brood XIV) in Brown County in Indiana emerged at the same general time as those from adjacent counties which suggests that the large broods have absorbed smaller ones by some such acceleration of emergence.

The emergence of periodical cicadas or 17-year locusts of the genus *Magicicada* has been observed in the eastern woodland areas of the United States since 1633 or 1634 when the Pilgrims of Plymouth Colony first encountered them. At this early date the cicadas came out of the ground in the spring and made the woods ring with their "singing" according to Moreton (1). The colonists had never seen such insects, but the Amerindians had, and predicted that pestilent fever would follow. The cicadas "sang", mated, laid their eggs, and died, and as the hot summer wore on the fevers came killing many of the colonists and Indians alike. In the autumn the pestilence abated, but it reappeared the following year. The Pilgrim "flies" or "locusts", however, were not seen again until 1651. They have since appeared as if regulated by clockworks every 17 years down to the last recorded emergence in 1974. Fortunately, the correlation with pestilent fevers has not proven constant.

The emergence of Brood X of the 17-year or periodical cicadas or 17-year locusts occurred in the three large areas in which the cicadas have appeared in previous emergences since 1715. In Indiana the three 17-year species of *Magicicada* occurred in most areas of emergence in about the same ratios observed previously. *Magicicada septendecim* (Linnaeus) was most numerous and *M. cassini* (Fisher) and *M. septendecula* Alexander and Moore were present in smaller numbers. On the Indiana University campus the two smaller species emerged later than *M. septendecim*, Young (2).

For the first time the senior author was able to detect mating aggregations on the Indiana University campus. Choruses of the males occurred at various points on the central wooded campus and in the vicinity of some outlying wooded areas. Very large choruses were reported and observed in Greene and other counties in Southern Indiana. The accompanying map summarizes the records for Indiana. Large black circles indicated a widespread and heavy emergence over most of a county. Smaller circles indicate light or spotty emergence. In nearly all cases examination of ovoposition scars, nymphs, or adults indicate that *M. septendecim* was the more numerous. The absence of records from central Indiana probably reflects the early and heavy clearing of these areas for agriculture. The cicadas have probably not had time to spread back into these areas to invade the wooded areas formerly cleared. Observations in several places makes it unlikely that the cicadas followed up stream gallery forests. Even moderate flooding seems to be enough to eliminate them although *M. cassini* shows some preference for lower situations.

It is still uncertain if the cicadas (like songbirds) have profited from the edge effects produced by forest clearing. They do emerge earlier and possibly in larger numbers along the edges of woods, but close observation on closed forest situations may underestimate the number of emergents. That is, in the mature beech-maple or other mature forests the cicadas climb up rapidly into the taller trees, and the estimation of emergence by counting exuviae may result in underestimation. On the other hand, the emergences in 1987 seemed equal to or greater than the emergences in 1970 and 1953 observed by the senior author.

Daily observations were made on the Indiana University Campus on eight areas differing somewhat in vegetation, slope, and drainage. These areas are roughly about 10 by 20 meters in which all adults and exuviae that could be found were collected. Emergence began nearly a week earlier than in 1970 and continued 1 to 3 days longer. Statements by previous workers suggesting a remarkable coordination of the emergences was not observable. Time and place of emergence was obviously influenced by isolation and ambient temperatures. Emergences early along the edges of woodland fragments was noted as in 1970, but as stated elsewhere it is not certain that this indicates a true edge effect. As the accompanying table shows any tendency for all cicadas, even in a restricted area, to emerge synchronously is masked by the local differences. [See Young (2)]

Areas may be described briefly as follows:

- Area 1. A fragment of mature forest, predominantly beech and maple, shaded by buildings on the east and west (Jordan and Myers halls). Essentially flat, well drained. This and all areas except 7 and 8 not compacted by crosswalks or other traffic. Tree shade heavy.
- Area 2. Cleared area (lawn) shaded on west by low temporary building. Well drained. Tree shade light. Emergence primarily around large beech trees.
- Area 3. Part of mature forest fragment on gentle north-facing slope, predominately mature beech-maple with understory of pawpaw and a few other shrubs and vines. Well drained. Emergence heaviest along open south edge. Tree shade moderate.
- Area 4. Area of mixed forest on either side of small temporary stream. Drainage in part poor. Tree shade heavy. Emergence heaviest along open south edge.
- Area 5. Area within mature beech-maple forest fragment on gentle south-facing slope (central quadrangle of campus). Understory of pawpaw and other shrubs. Drainage good. Tree shade moderate to heavy.

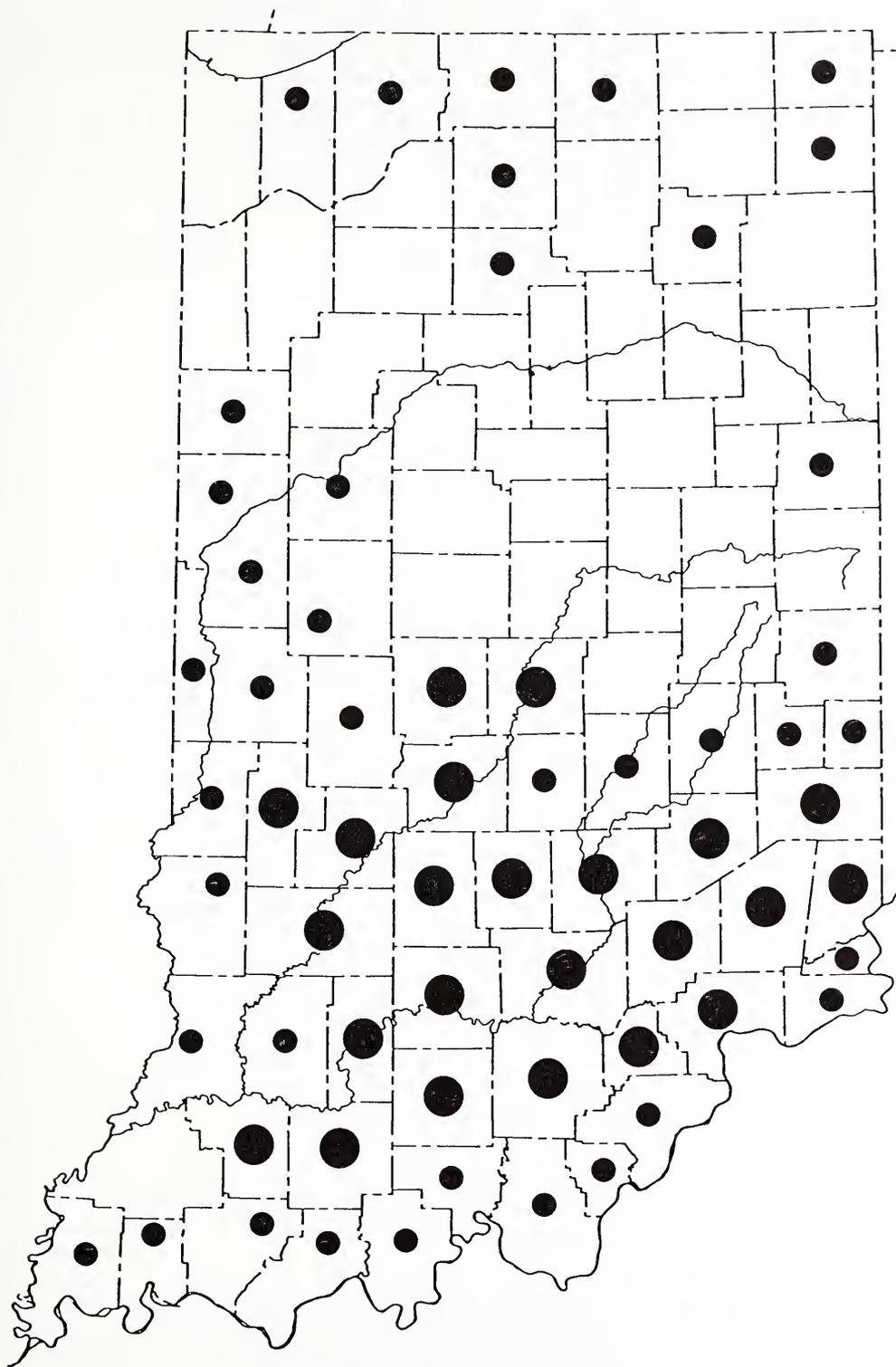


FIGURE 1. Map of Indiana showing counties and records of emergence of 17-year cicadas of Brood X in 1987. Larger circles indicate heavy and widespread emergences. Smaller circles indicate local or limited emergence. Three species of *Magicicada* were present in the emergences in southern Indiana. Map based on reports of county agricultural agents solicited by the junior author and personal observations.

- Area 6. Area at edge of mature beech-maple forest fragment on other side of a temporary stream (central quadrangle of campus). Understory of pawpaw and other shrubs. Drainage generally good. Tree shade moderate to heavy. Emergence heaviest along open eastern edge.
- Area 7. Lawn area immediately east of 6. Area compacted by mowing and foot traffic. Drainage good. Tree shade light. Emergence mainly around large beech trees.
- Area 8. (As indicated on table, had to be replaced by area 8A which was the closest area available, a grassy area near Mitchell Hall. Emergence here was heavier than the adult count indicates, but was primarily of *M. septendecim*.)

BROODS OF THE PERIODICAL CICADAS
(After Marlatt, 1907)

17-year broods

Brood	Early Dates	Distribution	Expected Next
I	1808	D.C., Ill., <i>Ind.</i> , Kan., Ky., Md., N.C., Pa., Va., W. Va. (Last Ind. record—1859!)	1995
II	1724	Conn., D.C., <i>Ind.</i> , Md., Mich., N.J., N.Y., N.C., Pa., Va., W. Va. (Last Ind. record—1911!)	1996
III	1844	Ill., Iowa, Mo., Neb., Ohio, W. Va.	1997
IV	1845	Ark., Okla., Iowa, Kans., Mo., Neb., Tx.	1998
V	1795	Ohio, Pa., Va., W. Va.	1999
VI	1847	<i>Ind.</i> , Del., D.C., Ga., Ill., Ky., Md., Mich., N.J., N.Y., N.C., Ohio, Pa., S.C., Tenn., Va., W. Va., Wisc. (Widely distributed, but scattered.) (Last recorded from Indiana in 1983.)	2000
VII	1797	N.Y., Pa., W. Va.	2001
VIII	1815	Ill., Md., Mass., N.J., N.Y., N.C., Ohio, Pa., S.C., W. Va., ? Ind. (1934)	2002
IX	1833	N.C., Ohio, Va., W. Va.	2003
X	1715	Ala., D.C., Del., Ga., Ill., <i>Ind.</i> , Iowa, Ky., Md., Mass., Mich., N.J., N.Y., N.C., Ohio, Pa., Tenn., Vt., Va., W. Va., Wisc. (Largest of the 17-year broods.) (Last Ind. Record—1987.)	2004
XI	1767	Conn., Mass., R.I.	1988
XII	1853	Ill., <i>Ind.</i> , Md., Ohio, W. Va. (Last Ind. Record—1938 in Orange County.)	1989
XIII	1854	Ill., <i>Ind.</i> , Iowa, Mich., Pa., Wisc., Ky., Md., Va., W. Va. (Last Ind. Record—1956.)	1990
XIV	1634	D.C., Ga., Ill., <i>Ind.</i> , Ky., Md., Mass., N.J., N.Y., N.C., Ohio, Pa., Tenn., Va., W. Va., Ala.	1991
XV	1839	N.J., N.Y., N.C.	1992
XVI	1857	Ark., Iowa?, Neb.	1993
XVII	1841	Ga., Iowa, Mo., N.Y., Va.	1994

TABLE 1. Records for Emergence of *Magiicada* species Adults Listed in Two Day Intervals for selected areas on the Indiana University Campus, Bloomington, Indiana

Area	Species	Dates of Emergence for May-June 1987												Total
		13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-1	2-3	4-5	
1	S	0	17	46	53	45	12	62	34	7	0	0	1	277
	Sc	0	8	23	30	17	29	35	20	5	0	0	0	169
	C	0	1	17	13	23	4	26	4	1	0	0	0	89
2	S	1	20	1	33	2	0	5	0	2	0	0	0	84
	Sc	1	22	22	3	12	0	1	0	3	0	0	0	163
	C	0	0	1	14	0	0	1	1	0	0	0	0	17
3	S	0	4	4	3	4	20	3	19	4	0	0	0	61
	Sc	1	14	1	7	6	11	0	9	4	1	0	0	54
	C	0	2	7	6	6	9	1	0	1	1	0	0	33
4	S	0	0	5	13	21	18	36	0	1	4	11	0	99
	Sc	0	0	0	0	2	48	0	0	0	1	10	0	61
	C	0	0	1	5	3	23	10	7	2	6	0	0	57
5	S	0	0	3	6	21	95	43	25	10	5	0	0	211
	Sc	0	0	0	0	2	8	11	7	0	0	0	0	28
	C	0	0	0	0	3	29	3	34	1	5	0	0	75
6	S	0	0	4	14	14	17	2	20	1	0	0	0	72
	Sc	0	0	0	0	0	1	0	2	0	0	2	0	5
	C	0	0	0	4	8	5	0	3	1	0	0	0	21
7	S	0	0	11	5	3	3	4	0	7	1	0	0	34
	Sc	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	4	2	3	0	1	0	0	0	10
8A**	S	0	0	3	1	0	0	0	0	0	0	0	0	4
	Sc	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0
Total												1622		

*S = *Magiicada septendecim* (Linnaeus)
 Sc = *Magiicada septendecula* Alexander & Moore
 C = *Magiicada cassini* (Fisher)

**Area 8A is a substitute for Area 8 of 1970 made necessary by destruction of former Area 8.

BROODS OF THE PERIODICAL CICADAS
13-year broods

Brood	Early Dates	Distribution	Expected Next
XVIII	1818	Ala., N.C., Ga., S.C., Tenn.	1997
XIX	1803	Ala., Ark., Ga., Ill., Okla., <i>Ind.</i> , Iowa, Ky., La., Miss., Mo., N.C., S.C., Tenn., Texas, Va., (Largest of the 13-year broods.)	1998
XX	1843	Ga., N.C.?, Va.?	1999
XXI	1844	Ala., Fla., Miss., Tenn.	2000
XXII	1806	La., Miss.	1988
XXIII	1820	Ala., Ark., Ga., Ill., <i>Ind.</i> , Ky., La., Miss., Mo., Ohio, Tenn., (Next Largest of 13-year broods.) (Last Indiana record—abundant in 1976.)	1989
XXIV	1873	Ark., Ill., La., Miss., Mo.	1990
XXV	none	no brood	—
XXVI	1849?	La., Miss., Texas?	1992
XXVII	1902	Miss.	1993
XXVIII	none	no brood	—
XXIX	1839?	Ga., Okla., S.C.	1995
XXX	1892	La., Mo.	1996

In Brown County, Indiana Brood XIV apparently emerged at the same time as Brood X in adjacent counties and in some parts of Brown County. Some emergence was also observed in Crawford and Harrison counties where Brood XIV was abundant in 1974 [Young (3)]. At that time there was some indication of restriction of this brood. Records for several southern Indiana counties could not be confirmed. It is possible that the emergence of Brood X from neighboring areas in some manner triggered emergence of Brood XIV. This suggests that a four-year acceleration of a brood might be frequent enough to influence the abundance of another brood. Thus Brood X and Brood XIV might owe their greater abundance and distribution to having absorbed some other broods. (This hypothesis is explored further in an accompanying paper by the junior author.)

Although Lloyd and Dybas (4) and others consider the four-year interval as important in brood emergence this is not positively proven and shorter periods of acceleration are certainly possible if not frequent.

Again during the 1987 emergence no real overlapping could be observed with areas where Brood XXIII emerged in southern Indiana counties in 1976 (Young, 5).

The construction by nymphs of "turrets" above the surface at the end of their burrows has been puzzling to workers in the past. It does not seem to be necessary for protection against flooding since the turrets are constructed in well drained as well as poorly drained situations. It has been observed during several emergences that moles are particularly active in the surface layer of the soil at the time the cicada nymphs are burrowing up to the surface. The relatively small turrets may offer a safe retreat out of the unusual hunting zone of the moles.

Acknowledgements

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Literature Cited

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