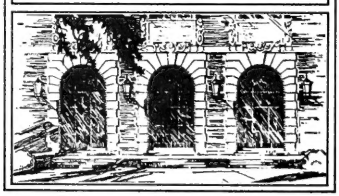

ILLINOIS BIRDS: VIREOS

Jean W. Graber, Richard R. Graber, and Ethelyn L. Kirk

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This paper, the tenth in a series on Illinois birds, concerns the vireos (Vireonidae). Seven species of the family occur in Illinois, one—the Philadelphia—only as a transient in spring and fall. Another species—the solitary vireo—has been found nesting only at Sand Ridge State Forest (Bjorklund 1979–1980, 1980–1981) and occurs in the state primarily as a transient. The other five species nest regularly in Illinois and occur also as migrants.

All previous papers in this series have followed the nomenclature and order of species in the 5th edition of the American Ornithologists' Union's (1957) *Check-list of North American Birds*. This paper follows, as a matter of course, the recently published 6th (1983) edition of the *Check-list*. The emphasis in our papers is on populations of birds, not their taxonomy, though we recognize that nearly any, and perhaps all, aspects of a species' biology may relate to its taxonomy.

In most respects the methods and policies applied in this paper are the same as those in previous papers of the series—most notably in Graber et al. 1970, 1977, and 1983. Where no authority is cited for a record, the record is ours. Sexual dimorphism in plumage is essentially lacking in vireos, and references to sex in our field observations are based on behavior—especially sustained singing by the birds observed.

Because many of the measurements included in this paper—especially those from the older literature—were made in English units, we initially (1983) elected not to make conversions to metric, but after further consideration decided to present both—the English and the metric equivalent following in parentheses. Exceptions are bird weights (grams only) and bird population figures in tables, given as birds per 40.5 ha (= birds per 100 acres).

We have used abbreviations for the regions referred to in the tables, i.e., N for north, C for central, and S for south. The regions are shown in Fig. 4.

As always, we are indebted to Marilyn Campbell and her colleagues at the Vermilion County Conservation District and the Vermilion County Audubon Society, not only for contributions of data, but for their sustained encouragement. H. David Bohlen of the Illinois State Museum gave us copies of his extensive notes on central Illinois birds and checked the original manuscript for errors. We are also indebted to members of the Champaign County Audubon Society for numerous nest records, and to Earl Long particularly for his counts of birds in an intensively cultivated area of central Illinois. Leroy Harrison of Olney generously shared with us his unpublished data on bird kills at a southern Illinois television tower. Before his studies, the only data available on tower kills for the entire southern region were those of Heye (1963) for Cape Girardeau.

Dr. Richard Bjorklund of Bradley University kindly provided current information on the nesting of the solitary vireo and gave us permission to use his photograph of the nesting bird. Bowie Hannah of Texico gave us a number of nest records and gave us permission to copy her slide of a yellow-throated vireo at its nest. Dr. Barrie Hunt of Eastern Illinois University shared with us his records on vireos in Illinois and reviewed the original manuscript.

Our colleagues at the Illinois Natural History Survey provided essential help in many ways with characteristic high efficiency and excellence. We are especially indebted to Dr. Glen C. Sanderson not only for his detailed editing of the manuscript, but for his continued support and encouragement of our studies on Illinois birds. This paper also benefited greatly from the questions and comments of Dr. Scott Robinson and Dr. Richard E. Warner.

WHITE-EYED VIREO

(Vireo griseus)

(Fig. 1)

Spring Migration

The earliest records of white-eyed vireos in Illinois were 2 April in southern and central Illinois (Fig. 2; Silloway 1906; Kleen 1976c) and 7 April in the north (Smith & Du Mont 1944a). Peak numbers have been seen 21 April–8 May in the south (20–45 per day), 2–17 May in the central region (8–12 per day), and 8–31 May in the north (3–6 per day). Musselman's (1913) count of 24 white-eyes at Quincy on 4 May 1912 (not shown) exceeds recent counts for central Illinois and indicates a large population for that early period. A white-eye killed by a storm over Lake Michigan on 16 April (Segal 1960) and one killed at the Olney tower on 16 May (L.

This paper is published by authority of the State of Illinois and is a contribution from the Section of Wildlife Research of the Illinois Natural History Survey. Dr. Jean W. Graber and Dr. Richard R. Graber were, until their retirement in 1983, Wildlife Specialists, and the late Miss Ethelyn L. Kirk served as a technical Assistant in the Section of Wildlife Research.

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Fig. 1.—White-eyed vireo at its nest, 11 June 1973, in Pope County.

Harrison unpublished 1978) indicate active nocturnal migration on those dates.

Spring populations, like the breeding populations, were highest in forest-edge and shrub habitat; no other habitat approached its importance (Tables 1 and 2). Spring densities were, on average, only slightly higher than June densities in both southern and central Illinois—not surprisingly, as the range does not extend much north of Illinois (Fig. 3). The numerous published spring (vs other seasons) records may represent overmigration or merely a special conspicuousness in spring because of the song. Turn-of-the-century counts (unpublished) of white-eyes by Frank Smith and his University of Illinois students in east-central Illinois were low (usually only one per day) by comparison with our more recent counts.

Distribution

White-eyed vireos probably nest in every county in Illinois, but the population in the northern region is still low, notwithstanding nest records there that date back into the last century (Fig. 1). Barnes (1890) considered the white-eye rare in Marshall County, where it is still uncommon, although Ferry found it common at Henry (Cory 1909). The same indication of a fluctuating population in northern Illinois is given by Mundt (1883). Strangely, old records are lacking for the Mississippi valley north of Quincy.

This species has made occasional population extensions northward, but has apparently been unable to sustain them in the past century. Whether recent apparent increases in the north (Bohlen 1978) will last, remains to be seen. The sustaining populations have been and still are on the forest soils of the southern half of the state.

In addition to breeding records plotted in Fig. 4, there are records for unspecified localities in McLean County (Kleen 1974c); Will, Warren, Kane, and Henderson counties (Kleen 1979–1980, 1980–1981); and Peoria and Tazewell counties (Loucks unpublished 1890, 1892).

Nesting Habitats and Populations

White-eyed vireos have never adapted to humans. Even early (historically), they remained on the outskirts of the village (Ridgway 1887). The nesting habitat has not been defined precisely—quantitatively—but has been described as hazel thickets and brier patches, tangled copse, and brushy swamps (Ridgway 1889,

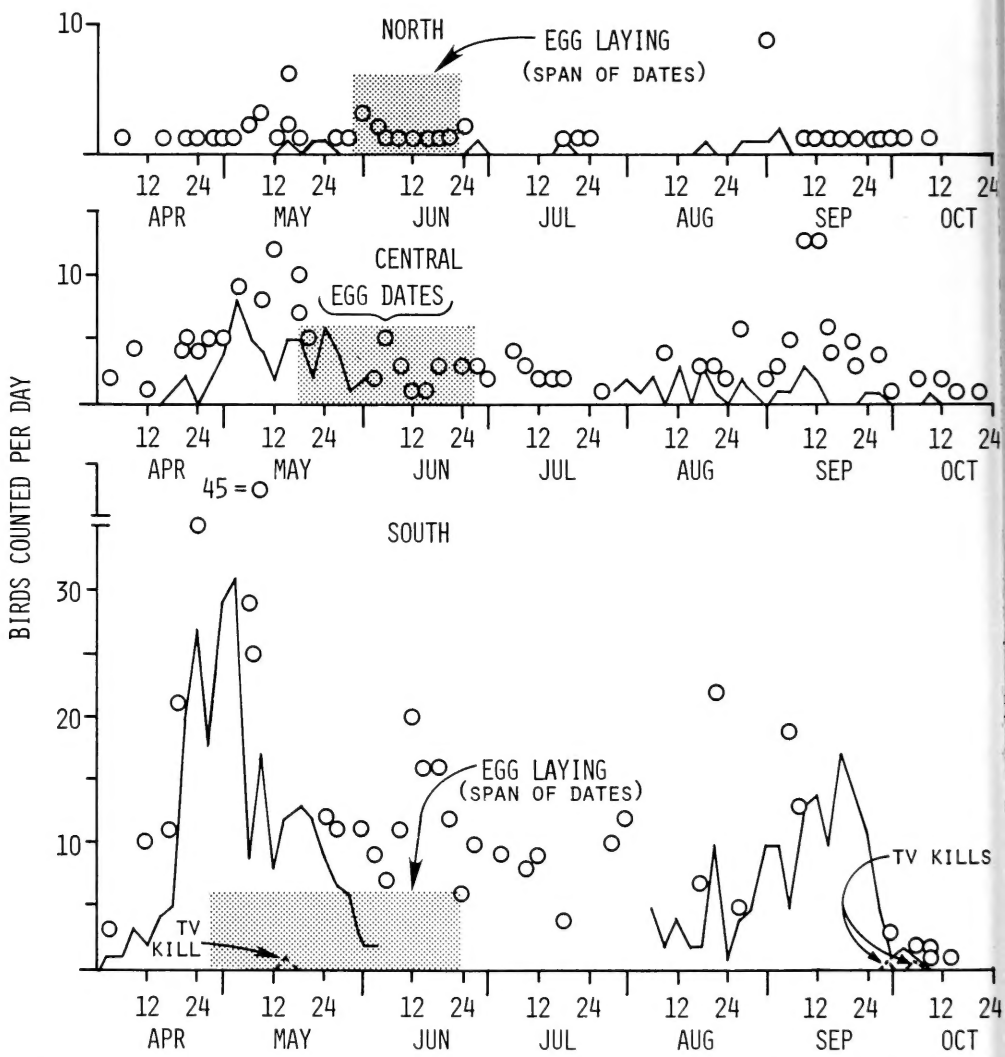

Fig. 2.—Egg-laying and migration seasons of the white-eyed vireo in different regions of Illinois. Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which eggs or laying have been recorded. The dash line shows numbers killed at television towers in southern Illinois during migration.

1923), and along the Mississippi near Keokuk, as wet, heavily timbered bottomland (Du Mont 1936). Our censuses indicate that forest habitat proper supports only modest numbers—more in bottomland than in upland (Table 2). On a strip-mined area white-eyes did not appear until 18–20 years after mining was stopped (Brewer 1958). Kendeigh (1982) found that white-eyed vireos in east-central Illinois did not reach peak numbers on abandoned farm land until 44 years after cultivation ceased. White-eyes favor the late successional stages, in contrast to Bell's vireo, the other common shrub vireo. Lowland shrub areas may be the most preferred habitat of the white-eye (Brewer & Hardy 1950; Table 2).

TABLE 1.—Spring and fall population densities of the white-eyed vireo in various Illinois habitats (1979–1981).

Season and Habitat	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 40.5 ha	
				Maximum	Mean
Spring (3 April–28 May)					
Mature bottomland forest	Piatt (C)	8	166	2.0	0.2
Mature bottomland forest	Johnson (S)	21	436	13.1	2.8
Mature upland forest	Piatt (C)	10	220		0
Mature upland forest	Pope (S)	23	454	9.6	0.4
Forest edge and shrub	Piatt (C)	9	183	8.9	3.8
Forest edge and shrub	Pope (S)	19	375	35.2	13.2
Loblolly pines	Pope (S)	12	214	2.4	0.2
Fall (1 August–12 October)					
Mature bottomland forest	Piatt (C)	21	425	2.0	0.1
Mature bottomland forest	Johnson (S)	21	419	7.7	2.3
Mature upland forest	Piatt (C)	26	506	2.2	0.1
Mature upland forest	Pope (S)	18	370	1.9	0.2
Forest edge and shrub	Piatt (C)	26	489	22.2	5.0
Forest edge and shrub	Pope (S)	20	407	18.0	6.9
Loblolly pines (1979–1980 only)	Pope (S)	10	177		0

TABLE 2.—Breeding populations of the white-eyed vireo in various Illinois habitats.

Habitat	Birds per 40.5 ha	Years	County or Region	Hectares Censused	Type of Census	Reference
Abandoned farmland (shrub and forest edge)	0–24 (avg 7.9)	1946–1971 (25 years)	Piatt (C)	18–24	Map	Kendeigh 1982
Shrub and forest edge	0–6.3 (avg 3.2)	1980–1981	Piatt (C)	38[a]	Strip	This paper
Forest (all types, including edge)	4–10 (avg 2.4)	1957–1958	South	138	Strip	Graber & Graber 1963
Bottomland forest	0–12.6 (avg 2.3)	1973–1981	South	1,129	Strip	This paper
Floodplain forest	+[b]	1981	Wayne (S)	8	Map	Keener 1981a
Upland forest	0–6.2 (avg 1.4)	1974–1981	South	623	Strip	This paper
Swamp and thicket	15.4	1950	Jackson (S)	5	Map	Brewer & Hardy 1950
Shrub, including edge shrub	2–6 (avg 3.6)	1907–1909	South	23	Strip	Graber & Graber 1963
Shrub, including edge shrub	1–4 (avg 3.1)	1957–1958	South	52	Strip	Graber & Graber 1963
Shrub and forest edge	9.3–14.4 (avg 12.4)	1979–1981	Pope (S)	62	Strip	This paper

[a]Strip censuses calculated as cumulative hectares.
[b]+ = less than one bird per 40.5 ha.

Comparative censuses indicated no noteworthy change in the white-eye population between 1907 and 1957 (Table 2), though Ridgway (1915b) noted a decline in southern Illinois. The higher densities in 1979–1981 suggest a recent increase, but may only reflect annual variation or habitat quality on a particular study area. The causes of variation in wild populations need long-term study.

Territory sizes of white-eyed vireos varied from 0.33 acre (0.13 ha) in swamp thicket in southern Illinois (Brewer 1955) to 3.45 acres (1.40 ha) in forest edge in central Illinois (Hensley 1948).

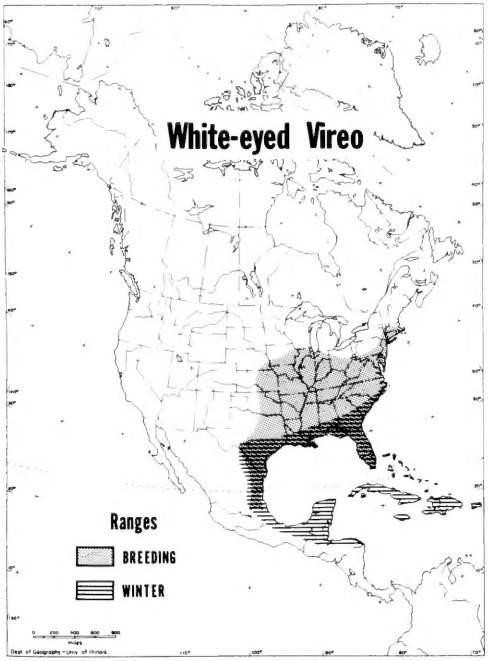

Fig. 3.—General distribution of the white-eyed vireo.

Our list of plants recorded as sites of 36 white-eyed vireo nests is notably diverse: sugar maple (*Acer saccharum*), red buckeye (*Aesculus discolor*), river birch (*Betula nigra*), blue beech (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), hazel (*Corylus americana*), hawthorn (*Crataegus* sp), persimmon (*Diospyros virginiana*), red cedar (*Juniperus virginiana*), spicebush (*Lindera benzoin*), ironwood (*Ostrya virginiana*), cherry (*Prunus* sp), shingle oak (*Quercus imbricaria*), multiflora rose (*Rosa multiflora*), poison ivy (*Rhus radicans*), sassafras (*Sassafras albidum*), buckbrush (*Symphoricarpos orbiculatus*), and winged elm (*Ulmus alata*). The list refers mainly to southern Illinois and is undoubtedly far from complete. No plant dominated strongly, but winged elm was somewhat more commonly used in the south, and multiflora rose in the central region. The heights of 39 nests ranged from 1.0 to 6.0 feet (0.3–1.8 m), with a mean of 2.5 feet (0.8 m).

Nesting Cycle

Ridgway (1873), Ferry (1907), and Farwell (1919), provided phonetic interpretations of the white-eyed vireo's distinctive song. Ridgway's was "chick'ty-beaver, limber stick," with emphasis on the first syllable of each word (Butler 1891). Singing continues to the end of September in the south, where we have heard courtship song as late as 29 August. The common alarm note—

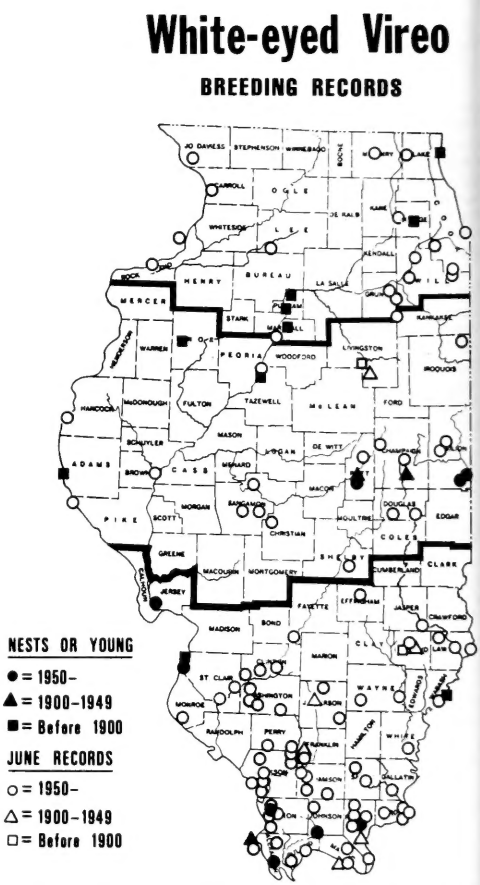

Fig. 4.—Breeding records of the white-eyed vireo in Illinois. Heavy lines show the limits of the three regions referred to in the text.

"chek-chek-chek"—repeated over and over, sometimes for a minute or more, is heard especially often in late August and September, possibly because young birds are present.

During April at least, the male is persistent in his courtship, following the female in flights through the shrubbery and from branch to branch, where he may perch a few inches in front of her and weave from side to side while singing a complicated, soft, bubbly courtship song. He accompanies her during the search for a nest site, and during building, brings some material. We have seldom found "male nests" of the white-eye of the sort so common among Bell's vireos. Perhaps there is a more balanced sex ratio among white-eyes, or perhaps male white-eyes do not often attempt such structures.

Fig. 5.—A white-eyed vireo on its nest, 11 June 1973, in Pope County.

At one nest that we observed (Fig. 5), the singing male attempted repeatedly, without success, to attach small dried, disc-shaped fungi to the outside of the nest. Nest material often includes the bark of cedar and river birch. Green moss is included in many nests, especially on the rim, in such a way as to suggest decoration. Thin ribbons of birch bark on the outside of many nests also give the appearance of decoration. The nests generally appear whitish externally. They are often placed near the center of a shrub or thicket.

Building in extreme southern Illinois often begins about 20 April. One pair started a nest on 21 April, then abandoned it for reasons unknown, and largely completed (except for the lining) a second nest just 2 feet away by the afternoon of 24 April. Another pair put the lining and moss decoration on their nest between 1000 and 1600 CST on 5 May. Construction of early nests probably requires about 3–4 days. At four nests where we saw both nest construction and the onset of laying, the delays in laying from the end of building were 2, 2, 4, and 5 days—delays that would seem to invite cowbird (*Molothrus ater*) parasitism.

The eggs are white and lightly speckled with brown. The laying season extends from at least 27 April to 24

June in the south (Fig. 2), where the dates, especially the late date, will likely be extended when more data are available. Data for the central and northern regions are even more incomplete.

Cowbird interference at nests of white-eyed vireos has complicated the acquisition of data on clutch size. Ten of 12 recent white-eye nests that reached the laying stage in Pope County were parasitized. The two unparasitized nests held three and four eggs. The parasitized nests had ultimate (highest seen) "clutches"—host and cowbird—of 4 and 2, 4 and 1, 4 and 1, 3 and 3, 3 and 2, 3 and 2, 3 and 1, 3 and 1, 3 and 1, and 1 and 1 eggs. In the sample of nest records (10) available for northern and central Illinois (mainly pre-1947), none was parasitized, and four-egg clutches (7 of 10) predominated. Three-egg clutches of this group were found after 9 June; the earlier season sets had four eggs each.

The incubation period at one Pope County nest was 15 days from the laying of the third egg to its hatching. Both adults take part in incubation. The duration of nestling life apparently has not been determined.

Nesting success in our small sample (12) of nests in Pope County was nil mainly because of cowbird interference, but a larger sample of nests is needed to understand rates of success and productivity. Present data indicate that this population could not sustain itself. We sometimes see (brown-eyed) young of this species in late summer; counts of these birds and the (white-eyed) adults should provide a good measure of productivity for particular populations. The laying season is sufficiently long in the south to indicate that more than one brood could be attempted, but studies of banded birds are required to determine the number of broods reared. The long laying period may actually be related primarily to a high failure rate in nesting.

Many white-eyes are conspicuously in molt during August and early September in southern and central Illinois. We have seen birds in fresh plumage as early as 4 September and at least one still in molt on 24 September.

Fall Migration

As in virtually all southern-ranging species, the white-eyed vireo's fall migration is rather obscure (Fig. 2). High counts of 6–13 in the period 27 August–14 September in central Illinois, and of 17–22 in southern Illinois, 21 August–18 September (Fig. 2), may indicate the peaks of the fall flights. Single specimens killed at the Cape Girardeau television tower on 29 September and 6 October (Heye 1963) indicate active migration on those dates. White-eyed vireos have been seen as late as 14 October at St. Louis (Cooke 1909), 20 October in the central region (Kleen 1979b), and 9 October in the north (Brodkorb 1926). A white-eye at Chicago on 17–18 December 1982 (Kleen 1983) was surely an abnormal occurrence.

The ratio of our counts of white-eyed vireos—spring to fall—was 6.6 to 1.0 in east-central and 2.2 to 1.0 in west-central Illinois. The more precise transect censuses showed a ratio of 1.0 to 1.3 in east-central Illinois. In southern Illinois the ratio was 2.7 to 1.0 (2.2 to 1.0 in the transects). The high ratio probably relates to the species' conspicuousness in spring, but could also represent overmigration.

As in spring, densities of the fall population were highest in the nesting habitat—forest edge and shrub (Table 1)—but fall densities were consistently below spring and summer densities in all habitats.

Food

None of the excellent studies we have seen on the food of the white-eyed vireo (Chapin 1925; Nolan & Wooldridge 1962) includes specific data for Illinois, but the general patterns observed in all (e.g., the high incidence of Lepidoptera in the diet) probably apply to Illinois as well. Nolan's observations in southern Indiana should be especially pertinent. Our only observation on the subject was of a white-eye that held a sulphur butterfly (*Colias philodice*) in its feet as it ate the body piece by piece.

Specimen Data

George (1973) concluded that young white-eyed vireos typically replace all major flight feathers during juvenile life, but that in certain midwestern populations, juveniles retain some or even all of the flight feathers until the post-nuptial molt. He also pointed out that wing area in juveniles is much smaller than in adults, i.e., that wing loading is unfavorable in juveniles.

The breeding population of white-eyes in Illinois is believed to represent *Vireo griseus noveboracensis* (American Ornithologists' Union 1957).

BELL'S VIREO

(Vireo bellii)

(Fig. 6)

Spring Migration

Bell's is probably the most inconspicuous of the Illinois vireos. Except for singing males, it may go largely undetected, and our counts are probably low in comparison with those for other species. Bell's vireos are not usually detected away from their nesting areas in shrub habitat.

Bell's is usually the last of the vireos to arrive in spring (Widmann 1907). The earliest reports in or near Illinois were 20 April in the south (Ridgway 1925a), 16 and 19 April in the St. Louis area (Comfort 1942), 27 and 28 April in the central region (Cooke 1888; Bohlen unpublished 1976), and 24 April in the north (Fawks 1966). High counts anywhere in the state have been less than 10 birds per day (Fig. 7), with peak numbers seen 11–28 May in the south, 17–24 May in central Illinois, and 24–31 May in the north.

Fig. 6.—Pair of Bell's vireos at their nest (A, the female; B, somewhat worn male, which sang regularly on the nest), 11 June 1984 at Rend Lake.

The counts of Frank Smith and his students in east-central Illinois earlier in the century were low (only one per day) by comparison with our counts.

Distribution

Illinois lies near the northeastern edge of Bell's vireo's range (Fig. 8). We would expect the species to nest in all Illinois counties, but it is generally absent from upland shrub areas in the Shawnee Hills of extreme southern Illinois (Fig. 9), where white-eyed vireos are abundant. Bell's may ultimately be found in bottomland shrub areas in these counties, however. The absence of records in many of the more northern counties (Fig. 9), where the species occupies both upland and bottomland shrub areas, probably reflects only insufficient exploration of those areas. In addition to records plotted in Fig. 9, there are breeding records for unspecified localities in Mercer County (USNM #26897); Lazewell and Peoria counties (Loucks unpublished 1892–1894); McLean, Hancock, Monroe, and Randolph counties (Kleen 1976–1977); Richland, Lawrence, and Madison counties (Kleen 1979–1980); and Rock Island County and eastern Will County (Kleen 1982).

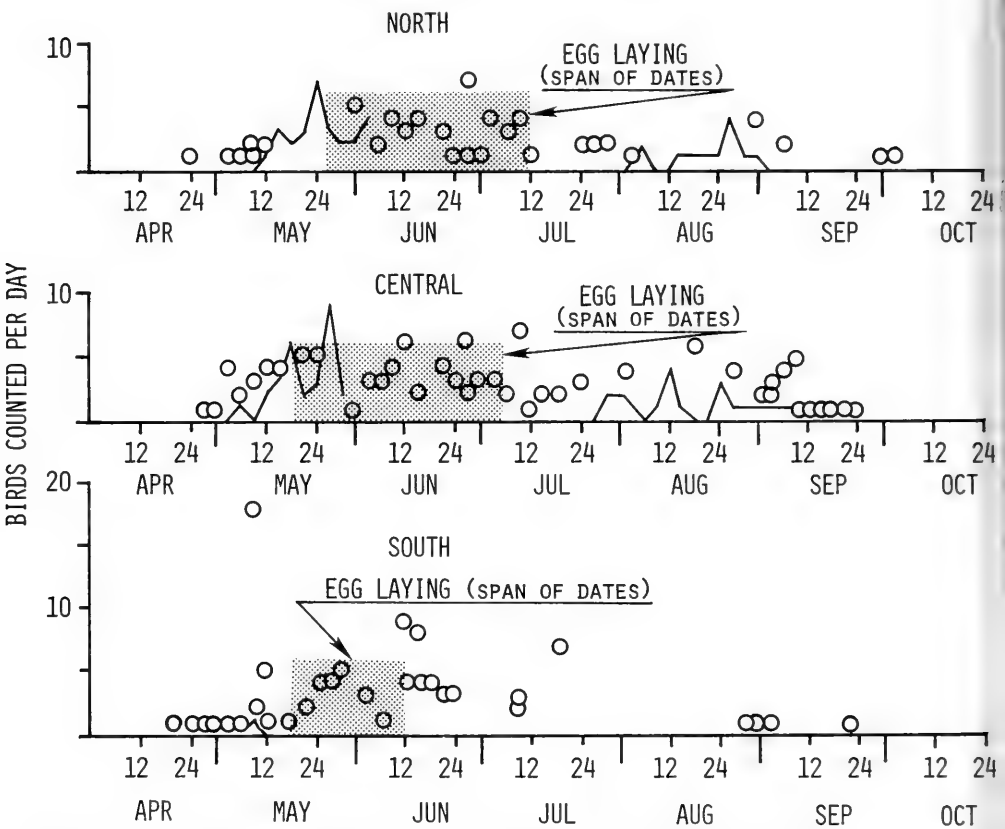

Fig. 7.—Egg-laying and migration seasons of Bell's vireo in different regions of Illinois (see Fig. 4 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which egg-laying has been recorded.

Nesting Habitats and Populations

Of the two shrub vireos in Illinois, Bell's is to prairie, or at least to open fields, as the white-eye is to forest. With deforestation, Bell's invades the open forest soil areas, but never the forest, whereas white-eyes are sometimes found in modest numbers in forest. Bell's vireos occupy both upland and bottomland shrub areas (Cunningham 1943), except for upland in the Shawnee Hills, where white-eyes are so numerous.

In general, the higher densities of Bell's vireo populations have been in prairie areas (Ridgway 1871; Du Mont 1947; Hopkins 1974; Linkletter 1975), but a shrub area on cutover forest in the forest-prairie ecotone (Vestal 1960) of western Sangamon County produced the highest densities on record (Robertson 1941, 1944; Table 3). However, forest succession there greatly reduced the population in just a few years (Robertson & Snyder 1948). Perhaps because its habitat is so transitory, Bell's populations are generally of moderate to low densities (Table 3). On abandoned farm land in Piatt County, Bell's vireos first appeared 28 years after cultivation ceased. The population peaked in the next 2–3 years, then disappeared after 10 years (Kendeigh 1982). On abandoned strip mine land in the south, Bell's was not found until 10–13 years after the cessation of stripping and disappeared after no more than 7 years (Brewer 1958). Bell's vireos utilized shrub growth along the channelized Kaskaskia River (Kleen 1976–1977), and they are often found in linear shrub growth along country roads, though not usually along busy highways. Bell's is somewhat more tolerant of people than is the white-eye (Silloway 1894a; Ruegnitz 1952); neither species is likely to have sustaining populations in urban areas. In the past, orchards provided habitat for Bell's (Hess 1910), but modern orchards probably do not.

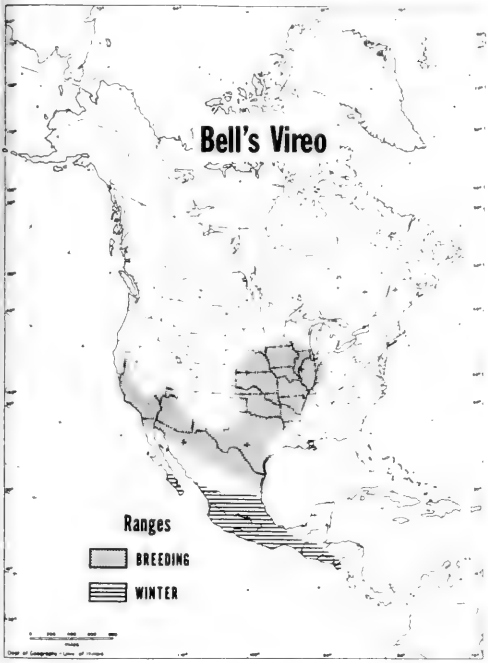

Fig. 8.—General distribution of Bell's vireo.

The historical data on Bell's vireo numbers do not show a consistent trend of gain or loss. The species was not detected in the 1907–1909 cross-country censuses, but was found in 1957–1958 (Graber & Graber 1963). The population may have increased at least on the east edge of the range (Nolan 1958), but in the Rock Island area older counts tended to be higher than more recent ones (Wilson 1906; Schafer 1923; Hodges 1953, 1954). The extensive loss of shrub habitat in recent decades (Smith & Du Mont 1944b; Graber & Graber 1976) implies a decline in Bell's population. The question is complicated because of the transient nature of the habitat.

Plant species used as nest sites by Bell's vireos in Illinois are common edge species (Table 4). Bellrose (1936), Cunningham (1943), Du Mont (1947), and Eifert (1949) all referred to Bell's vireo nesting in willows, but it is uncertain whether all references were to nest sites or to habitat in general. Heights of 58 Bell's vireo nests ranged from 1 to 4 feet (0.3–1.2 m), with a mean of 2.47 feet (0.75 m)—virtually the same as nest heights of the white-eye. A reference to nests as high as 20 and 40 feet (Ballow 1878) is likely a misprint or otherwise in error.

The only data on territory size of Bell's vireo is that of Hensley (1950) in east-central Illinois, where a pair occupied 3.1 acres of grass and shrubs, and an unmated male 2.7 acres in the same habitat. Nolan (1960) observed similarly large territories in Indiana.

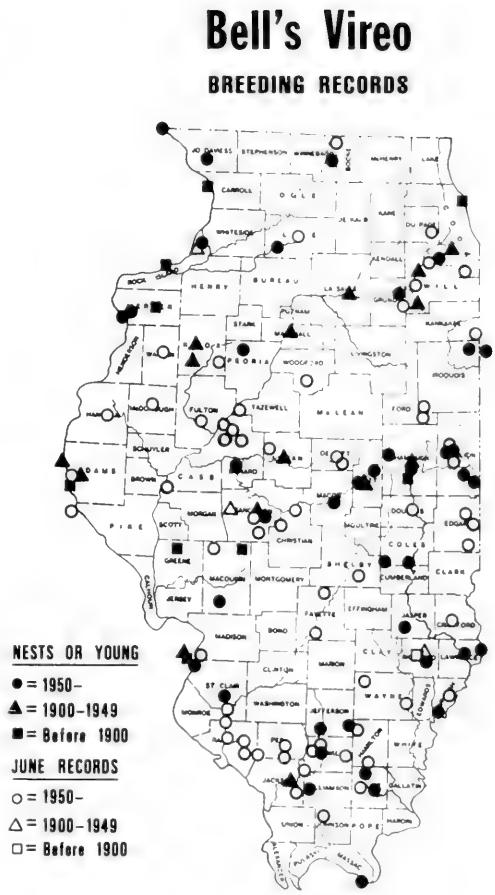

Fig. 9.—Breeding records of Bell's vireo in Illinois

Nesting Cycle

Information on the nesting cycle of Bell's vireo in Illinois comes especially from the studies of Silloway (1894a), Du Bois (1940), Pitelka & Koestner (1942), and Hensley (1950), all of whom worked in central Illinois.

Silloway described the song as a short, emphatic warble uttered nervously and with increasing force and rapidity to the end. His phonetics for it: "Quit, oh quit, now quit, why can't you hear." The song has a harsh, irritated quality and often ends with a definite ascending or descending note or phrase. Silloway (1913) also noted that the song is delivered in two keys: (1) higher and clearer—more distinctly articulated—and (2) much lower and harsher, the notes seeming to come from closed mandibles. Du Bois (1940) mentioned a song

TABLE 3.—Breeding populations of Bell's vireo in various Illinois habitats.

Habitat	Birds per 40.5 ha	Years	County or Region	Hectares Censused	Type of Census	Reference
Woods (unspecified)	0–10 (avg 2.0)	1914–1923	Rock Island (N)	8		J.J. Schafer unpublished notes
Cutover upland oak-hickory forest	14–61 (avg 44.4)	1941–1942 1944, 1948	Sangamon (C)	20	Map	Robertson 1941, 1942, 1944; Robertson & Snyder 1948
Disturbed mixed prairie (shrubs in grassland)	5–20 (avg 15.2)	1975–1977	Grundy (N)	16	Map	Linkletter 1975, 1977; Linkletter & Wooley 1978
Abandoned farmland (shrub and forest edge)	0–10 (avg 5.4)	1946–1958[a] (13 years)	Piatt (C)	18–24	Map	Kendeigh 1982
Shrub	0–3 (avg 2.0)	1957–1958	Central	20[b]	Strip	Graber & Graber 1963
Pastures	0–2 (avg 0.6)	1957–1958	Central	70	Strip	Graber & Graber 1963
Early shrub	18	1966	Vermilion (C)	9	Map	Karr 1968
Maintained invaded grassland	8.8	1974	Willow Slough, Indiana	9	Map	Hopkins 1974
Shrubby field and forest edge	6	1949	Richland (S)	±24	Map	Stine 1949
Swamp and thicket	7	1950	Jackson (S)	5	Map	Brewer & Hardy 1950
Shrub	3–4 (avg 3.9)	1957–1958	Central	52	Strip	Graber & Graber 1963

[a]Bell's vireo present only to 1958; the censuses continued to 1971.
[b]Strip censuses calculated as cumulative hectares.

pattern in which the phrases were alternately interrogative and exclamatory and another song characterized by loud squeaks. The male often sings near, and even on, the nest. Pitelka & Koestner (1942) observed a male sing 98 times between 0622 and 0750 on 2 July. They also saw a female sing at one nest.

TABLE 4.—Plants recorded as nest sites of Bell's vireos in (mainly northern and central) Illinois. The scientific name is not included if lacking in the original source.

Species	Number of Plants
Blackberry and raspberry (*Rubus* spp.)	11
Cherry and plum (*Prunus* spp.)	8
Hazel (*Corylus americana*)	8
Dogwoods (*Cornus racemosa, C. stolonifera*)	6
Box elder (*Acer negundo*)	6
Crab apple (*Malus* sp.)	3
Hawthorn (*Crataegus* spp.)	2
Currant	2
Elm	2
Honeysuckle	2
Red cedar	1
Willow (*Salix* sp.)	1 (?)
Witch hazel	1
Osage orange (*Maclura pomifera*)	1
Multiflora rose (*Rosa multiflora*)	1
Shingle oak (*Quercus imbricaria*)	1
Hackberry	1
Red maple (*Acer rubrum*)	1
Autumn olive (*Elaeagnus umbellata*)	1
Total	59

Scold notes of Bell's have been described as a series of single notes, "chick, chick, chick . . . ." (not high in pitch, uttered by the female at the nest and a rapid "chee, chee, chee . . . ." or a somewhat wrenlike "chur, chur, chur . . . . " uttered by adults carrying food to young (Du Bois 1940).

While white-eye nests are often near the center of shrubbery, those of Bell's vireo are more often on the outer edge, but well concealed from above. They are usually made of grayish weed, bark shreds and fibers, and dried leaves, held with gossamer and lined with fine grasses (Silloway 1894a; Crone 1896; Du Bois 1940). Bell's nests are drab looking by comparison with white-eye nests. Two Bell's nests measured by Du Bois were 1.75 inches (4.44 cm) each for the inside diameter at the rim, inside depth was 1.62 and 1.87 inches (4.11 and 4.75 cm), outside diameter was 2.50 inches (6.35 cm) each, and outside depth was 2.50 and 2.75 inches (6.35 and 6.98 cm.)

Both adults have been observed to participate in nest building (Hensley 1950). At one nest the female made nine trips and the male six in 70 minutes. At localities in northern, central, and southern Illinois, we observed unmated male Bell's vireos start nests which they did

not (could not?) carry beyond the stage of a thin-walled, fragmentary structure—a mere outline of a real nest. Hensley (1950) noted that the female (alone) finished the interior of the nest. Pitelka & Koestner (1942) and Hensley (1950) found that nest construction required 1–5 days.

Egg laying began on the first day after nest completion at one nest (Hensley 1950) and on the second day after completion at another (Pitelka & Koestner 1942). The eggs are white and finely speckled with cinnamon or reddish brown (Fig. 10). In a sample of 32 May–July nests of Bell's vireos spaced fairly evenly (historically) from 1881 to 1981, 26 had clutches of four eggs and 6 had three eggs each. All were nests apparently unmolested by cowbirds. In 40 years Harold Holland examined more than 100 Bell's vireo nests, none of which held more than four (vireo) eggs (Bent 1950). Holland (1923) also found two nests that contained both cowbird and red-winged blackbird eggs, the latter species, of course, a spurious parasite. Cowbird parasitism is probably a serious problem for Bell's vireo. At least four of five nests studied by Pitelka & Koestner (1942) were parasitized. In a sample of seven nests studied by Silloway (1894a) *none* was parasitized, and another early student (Crone 1896) had similar experience. In a sample of 12 more recent (1968–1981) northern and central Illinois nests, 4 were parasitized by cowbirds. Larger samples are needed to discover whether the problem is growing.

Pitelka & Koestner (1942) reported that intervals between the laying of the last egg in failed nests and the laying of the first egg in new nests were 6, 6, and 5 days on different occasions. One female laid 12 eggs in 26 days. At one nest, incubation began with the first egg (Pitelka & Koestner 1942), at another with the second egg (Hensley 1950). Both adults participate in incubation. Hensley observed incubation for 3 hours and 26 minutes, during which the male was on the nest 1 hour and 29 minutes and the female, 1 hour and 55 minutes. The average attentive period was 17.8 minutes for the male and 23 minutes for the female. The male stayed away from the nest as long as 47 minutes, the female no more than 25. Eggs were not left exposed except for the few seconds required for the changeover. The incubation period was 14 days from the laying of the second egg (Pitelka & Koestner 1942; Hensley 1950).

Both adults also brooded and fed the young. During 2.5 hours in the middle of the day when the (three) nestlings were 3 days old, Hensley observed that they were fed, on average, 9.2 times per hour. The male brought food 14 times and brooded 25 minutes in four sessions. The female brought food 11 times and brooded 51 minutes in two sessions. At a nest with (two) nestlings 5.5 days old, Du Bois (1940) saw the female feed seven to eight times between 0650 and 0834. The food of the young nestlings at both nests was almost entirely small naked Lepidoptera larvae.

The newly hatched young are naked and pinkish or reddish, and the mouth cavity is yellowish without markings (Du Bois 1940). At 5 days they were still essentially naked and their eyes were still closed, but they were much larger. Dark feather tracts were showing in the midline of the anterior part of the back, on the edge of the wing, and on the crown and caudal tracts, and white feather tracts were visible on the underparts.

Fig. 10—Nest and eggs of Bell's vireo, 14 June 1984, at Rend Lake

At one nest, a young bird stayed 11 days (Pitelka & Koestner 1942), and at another, 12 (Hensley 1950). Hensley found the young 30 feet from the nest the day after fledging and 300 feet away 5 days after fledging. They were being fed by the female. The young uttered a soft, single-noted chip by which the adult located them.

Data on nesting success and productivity, and annual variation therein, are much needed for adequate samples of Bell's vireo nests (as well as other species) from the three regions of Illinois. A sample of 15 nests (1968–1981) with fairly complete histories from northern and central Illinois had success rates of 31.8 percent for nests and 23.0 percent for eggs, and produced (to fledging), on average, only 0.9 young per nest (2.6 per successful nest). These rates are much below those observed by Nolan (1960) in Indiana. Causes of nest failure are unknown on any quantitative basis. One of the 15 nests mentioned above was torn apart, apparently by a mammal, and farm machinery destroyed another. Most (78

percent) failed in the incubation or laying stage. Cowbirds may have accounted for many of these, as Bell's vireos tend to desert parasitized nests (Friedmann 1963), especially following the removal of an egg by the cowbird (Pitelka & Koestner 1942). None of the 15 fledged a cowbird. Du Bois (1940) reported on a nest in which the young were killed by a heavy infestation of mites, and Pitelka & Koestner (1942) reported one young lost to an infestation of fowl mites (*Liponipsus sylviarum*).

Bell's vireos sometimes apparently attempt to rear more than one brood per year, as indicated by a study of banded birds in Indiana (Nolan 1960), but the incidence of such behavior and its effect on a population remain to be determined.

Fall

A Bell's vireo (adult?) was in molt in Richland County as early as 2 July (USNM 114864), and some birds in northern and central Illinois appeared to be in fresh plumage by 28–29 August.

As with many species, the fall departure of Bell's is not a conspicuous event (Fig. 7). We saw only 1.0 Bell's in fall to 2.2 in spring in northern Illinois, and 1.0 to 1.6 in the central region. Most of the birds detected were singing. We did not detect the species in our fall census transects. Bell's vireos have been found singing on territories as late as 7 September in northern Illinois (Mumford 1959a) and 5 September in central Illinois (Pitelka & Koestner 1942). In central Illinois, highest counts (five to six birds) came 18 August–8 September. Bell's vireo has not been recorded as a television tower casualty in Illinois, and nothing is known of the actual migration flights.

The latest fall records of Bell's in Illinois were 2 October in the north (Ford 1956), 23 September in the central region (Kleen 1982), and 22 September in the south (Widmann 1907). A figure in Anderson & Bauer (1968) seems to indicate an early October record for the St. Louis area, but the precise date was not stated. A Bell's vireo at Barrington, Illinois, on 14 November (Fawks 1965) was very late—possibly an accidental record.

Specimen Data

Illinois specimens of Bell's vireos have been referred to *Vireo b. bellii* (Ridgway 1904; Brodkorb 1930).

Weights of Indiana specimens of both adult and immature Bell's vireos were presented by Nolan (1960).

SOLITARY VIREO

(Vireo solitarius)

(Fig. 11)

Spring Migration

The earliest reports of solitary vireos in Illinois were 15 and 21 April in the south (Fig. 12; Cooke 1909); 18, 20, and 21 April in the central region (Hunt unpublished 1976; Bohlen unpublished 1979; Kleen 1974b); and 11 and 18 April in the north (Fig. 12; Chase 1899). Peak numbers have been seen 21 April–13 May in the south (3–5 per day) and 2–18 May in the central region (4–11 per day). In the north only 1–2 solitary vireos have been reported per day in spring (Fig. 12)—numbers that do not realistically reflect the population there. However, the highest single county count of the solitary during 10 years (1972–1981) of the Audubon Spring Bird Count was 21 birds—on 6 May—in McHenry County, where the number of observers was 14, i.e., fewer than 2 birds per observer (Kleen 1981b). At Davenport, P.C. Petersen *banded* 14 solitary vireos on 10 May, and we would expect field counts to be higher in northern Illinois than present data show.

Probable transient solitary vireos have been seen as late as 8 June in northern Illinois (Ferry 1908) and 19 May in the south (George 1968). The record of a male solitary in Marshall County on 6, 23, and 24 June (Kleen 1982–1983) is enigmatic—extremely late for a transient, but with no certainty of breeding in the area. However, the locality is not far from the one known breeding area in the state (see below).

Cooke (1884a, 1888) found that the migration of the solitary vireo in the Mississippi Valley was relatively fast compared with those of other species there.

Both Bohlen (1978) in Illinois and Dinsmore et al. (1984) in Iowa felt that solitary vireos preferred upland and edge habitats. However, the highest spring densities in our censuses were in bottomland forest, both in central and southern Illinois (Table 5), leading us to suspect that transients have no particular habitat preference but concentrate where the food is.

Solitary vireos regularly sing during both their spring and fall sojourns in Illinois (Ridgway 1889, 1915a; Lewis 1923). Ridgway (1889) described the song, which sounds somewhat like a soft, hesitant yellow-throated vireo song.

The regular breeding range of the solitary vireo lies north of Illinois (Fig. 13). Bjorklund 1979–1980, 1980–1981) has presented data on the nesting of the solitary vireo in Illinois. Despite references to the breeding or summering of this species in northern Illinois (Roberts 1923; George 1971; American Ornithologist's Union 1983), the latter of which may refer to Bjorklund (1979–1980), the only certain nestings in the state have been at Sand Ridge State Forest (Mason County) in mixed pine plantation-hardwood forest habitat (Bjorklund 1979–1980, 1980–1981). There a nest 10 feet (3.0 m) high in a 45-foot (13.7 m) white pine (*Pinus strobus*) was found on 16 May 1979. On 3 June the nest contained one vireo egg that never developed and a nestling cowbird that survived to at least 9 June. The cowbird was gone—as were the vireos—on 13 June. The following year a pair of solitary vireos was present in the same area in May and a completed nest was found on 14 June within 50 feet (15.2 m) of the 1979 nest site. Subsequently, that nesting failed. As Bjorklund (1980–1981) pointed out, this second nesting attempt seems to represent a clear example of homing by one or both vireos, as the species

Fig. 11.—Solitary vireo at its nest at Sand Ridge State Forest, Mason County. Photo by Dr. Richard Bjorklund.

was not known to occur anywhere else in the state in summer, and possibly no closer than the Indiana Dunes (Fawks 1968b)—about 170 miles (274 km) away.

Fall Migration

The earliest indication of the fall migration in Illinois was Gault's (1901b) record of a solitary vireo at Glen Ellyn on 11 August. This record is exceptionally early, as the earliest other fall records for the north were not until 3 and 4 September (Schafer 1923; Clark & Nice 1950). Early fall records for the central region were: 29 August and 1 September (Bohlen unpublished 1977; Kleen 1980a) and for the south, 26 August and 8 September (George 1968; Wilhelm 1954). The earliest tower-killed specimens were found 20 September in central Illinois and 28 September in the south. High counts in the north were three and nine per day on 7 and 29 September (Fig. 12). At Davenport, P.C. Petersen *banded* 13 solitary vireos on 20 September 1977 (Dinsmore et al. 1984) and a total of 38 between 24 August and 12 October 1977—considered to be above-average numbers (Halmi 1977). By comparison, our fall (1968) count was only 15 solitaries. In the central region, peak numbers (6–12 per day) were seen 26 September–10 October. In the south again, the counts were low, the highest only three per day, on 5 and 16 October (Fig. 12). Higher numbers will surely be found in late September as well as in October. Much of the migration probably occurs regularly in October (Fig. 12), and there are so many November records (Sanborn 1922; Hagans & Shaw 1961; Fawks 1967; Kleen & Bush 1972; Kleen 1975a, 1976b, 1978, 1980b; Bohlen 1978, unpublished 1981 and 1982)—to 26–27 November (Fawks 1967; Kleen 1980a)—that it seems certain that some migration in November is normal for the solitary vireo.

The ratio of our counts—spring to fall—was 1.0 to 3.7 in the north, 1.0 to 3.1 in the central region (1.0 to 2.6 in the census transects), and 1.3 to 1.0 in the south (1.0 to 1.0 in the transects). The low fall ratio in the south appears to be typical of many Illinois species, including most warblers (Graber et al. 1983). At Davenport, P.C. Petersen's banding study showed more solitary vireos to be present in fall than in spring, but at Chicago, Dreuth saw the species with greater frequency in spring than in fall (Clark & Nice 1950).

Relatively few (19 picked up) solitary vireos have been killed at central Illinois television towers—probably commensurate with a generally low state population, as shown by the counts and censuses (Table 5).

The habitats with highest densities of solitary vireos in fall were forest edge and shrub in the central region and in pine habitat in the south (Table 5), in both cases differing from those in spring.

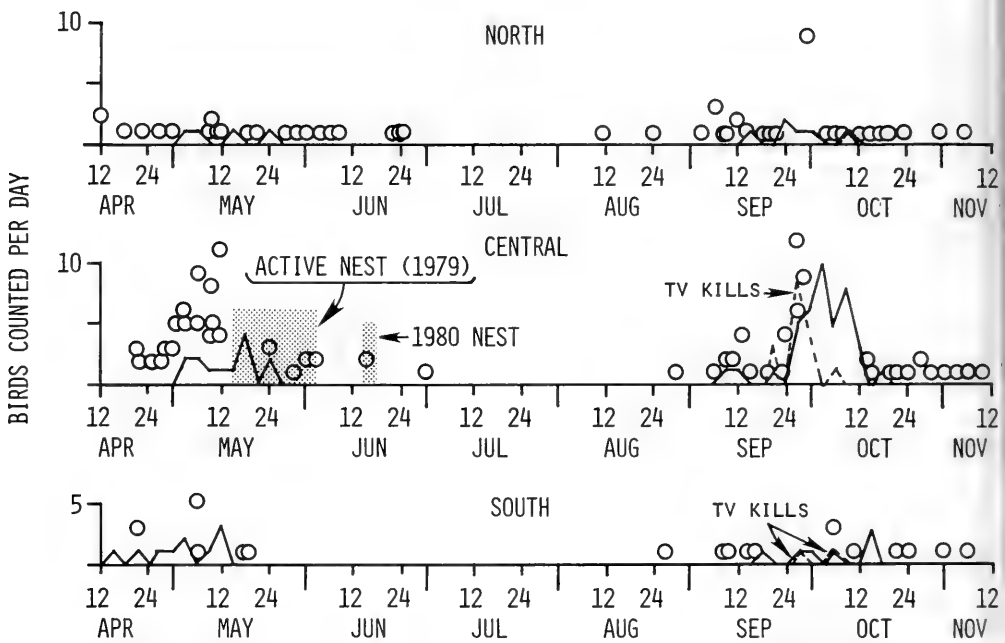

Fig. 12.—Migration seasons of the solitary vireo in different regions of Illinois (see Fig. 4 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded area (central region) shows time of nesting activity. Dash lines show numbers killed at television towers during fall migration.

Our only observations on food of the solitary vireo were of individuals eating a very large (3-inch or >75-mm), Lepidoptera larva on 28 September and fruit of *Cornus florida* on 5 October—also listed by Chapin (1925).

Gross weights of specimens killed, 27 September–12 October, were: one adult male (still in molt on back, rump, and breast on 27 September), 18.3 g; two very fat immature males, 16.5 and 16.7 g; and one immature female, 16.5 g. Of six specimens we aged from this sample (two were not weighed), only one was an adult.

TABLE 5.—Spring and fall population densities of the solitary vireo in Illinois (1979–1981).

Season and Habitat	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 40.5 ha	
				Maximum	Mean
Spring (21 April–22 May)					
Mature bottomland forest	Piatt (C)	5	105	3.7	1.2
Mature bottomland forest	Johnson (S)	11	227	5.7	0.5
Mature upland forest	Piatt (C)	7	149	2.0	0.8
Mature upland forest	Pope (S)	9	183		0
Forest edge and shrub	Piatt (C)	6	121	2.2	0.3
Forest edge and shrub	Pope (S)	10	201		0
Loblolly pines	Pope (S)	6	110		0
Fall (27August–16 October)					
Mature bottomland forest	Piatt (C)	18	364	2.0	0.3
Mature bottomland forest	Johnson (S)	15	312		0
Mature upland forest	Piatt (C)	19	367	2.0	0.1
Mature upland forest	Pope (S)	14	296		0
Forest edge and shrub	Piatt (C)	21	416	17.9	1.4
Forest edge and shrub	Pope (S)	16	323		0
Loblolly pines (1979–1980 only)	Pope (S)	8	141	6.7	0.9

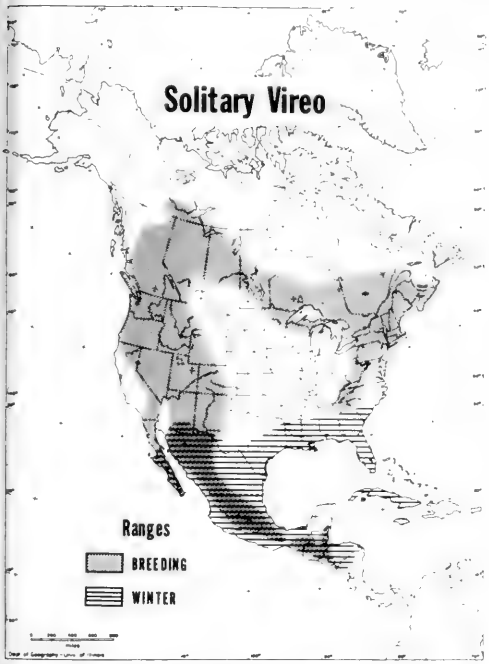

Fig. 13.—General distribution of the solitary vireo.

YELLOW-THROATED VIREO

(Vireo flavifrons)

(Fig. 14)

Spring Migration

The earliest reports of yellow-throated vireos in or near Illinois were 31 March and 8 April in the south (Fig. 15), 28 March and 14 April in the central region (Kleen 1975b; Peterjohn 1981), and 14 and 25 April in the north (Peattie 1938; Smith 1942; Clark & Nice 1950). Peattie's reference to "many" yellow-throated vireos at Kennicott's Grove on 14 April may cast doubt on that record. The yellow-throated is the first of the vireos to arrive in spring (Widmann 1907), but large numbers in the north so early would be unusual.

Highest numbers were seen 16 April–8 May in the south (12–26 per day), 7–14 May in the central region (6–7 per day), and 13–22 May in the north (4–10 per day). The migration probably extends into early June, at least in the north (Ferry 1908). The counts of Smith and his students (1903–1925) in east-central Illinois were not notably different from our more recent counts. Spring densities in the south were higher in bottomland than in upland forest and were about three times higher than breeding densities in bottomland (Tables 6 and 7). In central Illinois, densities in spring and June were similar.

Distribution

The yellow-throated vireo probably nests in every county in Illinois, and the absence of records for many counties (Fig. 16) almost certainly implies inadequate exploration. A forest species, the yellow-throated is most numerous in the south (Fig. 15), though it occurs throughout the eastern deciduous forest (Fig. 17). In addition to records plotted (Fig. 16), there are June records for unspecified localities in Kane County (Greenberg 1982), the "dunes area" of Chicago (Sanborn 1921), and a nest on the Cook-Lake county line (Ford 1956).

Nesting Habitats and Populations

The breeding habitat of the yellow-throated vireo seems poorly defined. Primarily a forest interior species (Kendeigh 1982), it also sometimes nests in forest edge and in bottomland (Ridgway 1874; Gates 1911) as well as upland (Barnes 1890; Cahn & Hyde 1929)—not conspicuously favoring one over another (Table 7). It is unlikely that human residential areas could provide even marginal habitat for this species. Characteristics of vegetation, which we measured (Graber et al. 1977) in 18 forest study areas in southern and central Illinois, showed no consistent relationship to yellow-throated vireo populations. However, the higher populations in bottomland forest were in stands with relatively high densities (50+ per acre or 123+ per ha) of trees over 10 inches (25.4 cm) DBH ($r = 0.538$, $n = 10$, $p > 0.05 < 0.10$) and high densities (7+ per acre or 17+ per ha) of trees in the 14- to 16-inch (36- to 41-cm) DBH class ($r = 0.772$, $n = 10$, $p < 0.005$). The relationship did not hold for upland stands, and the data may simply imply that yellow-throated vireos favor forest with relatively high numbers of moderately large trees. Nests we have seen have generally been in fairly large (> 10 inches or 25.4 cm DBH) trees.

Few data are available on nest sites—or other habitat features—in Illinois. Of 11 nest sites known to us in southern and central Illinois, 4 were in shagbark hickories (*Carya ovata*), 3 in oaks (*Quercus rubra, Q. alba*), and 2 in maples (at least one *Acer saccharum*), plus 1 each in a sweet gum (*Liquidambar styraciflua*) and an "ash." The nests were generally high (15–50 feet or 5–15 m), with a mean of 30.5 feet (9.3 m).

Four territories of yellow-throated vireos measured in upland forest in east-central Illinois by Allison (1947) ranged from 2.4 to 3.3 acres (0.7–1.0 ha), with a mean of 2.8 acres (0.8 ha).

The yellow-throated vireo is usually a low-density species in Illinois, averaging under 10 birds per 40.5 ha, often only 1 or 2 per 40 ha for large census areas (Table 7). There is no evidence that the species' status has changed greatly within historical times. The yellow-throated vireo was not detected on the first cross-country censuses in Illinois, probably because of the small amount of forest censused in 1906–1909 (Graber & Graber 1963). Notably high populations have been reported in northern Illinois in some years (Boulton &

Fig. 14.—Yellow-throated vireo working on its nest in Jefferson County, May 1982. Photo by Bowie Hannah.

Pitelka 1938a; Mumford 1959b), but numerical values cannot be assigned to these observations.

Even more than for most Illinois species, data on the breeding biology of the yellow-throated vireo are meager, probably because of the (high) location of nests. No Illinois data exist on such fundamentals as time requirements for any phase of the nesting cycle, nesting success, productivity, or the number of broods attempted. We have heard two distinctly different songs from yellow-throated vireos in Illinois: (1) the most common, a leisurely delivered, vibrant series of phrases (three or more)—"shree-ur, shree-ur, shree-ee,"—and (2) a vocalization that sounds like a song but which may have an entirely different function than the common song. Our phonetics are: "perteee, terteee, pee-yurr," the "teee" notes rising and the last note falling. A call that is probably an alarm call is an accelerating series of harsh "cha-cha-cha" notes, similar to a call uttered by the solitary vireo. At least one of a pair of yellow-throateds, looking for a nest site, called "pink-pink-pink" almost continually as they went from tree to tree.

Yellow-throated vireos have been seen building nests between 23 April and 19 June in southern Illinois, where the span of dates for egg-laying was 10 May–15 July. Egg dates in the north were 1 June–20 July (Fig. 15). The eggs are creamy white and speckled about the large end with reddish brown (Reed 1965). Five Illinois nests of unknown histories, but not parasitized by cowbirds, had clutches of four eggs (two nests, central and south) and three eggs each (three nests, north and central). In addition, a Vermilion County nest had four eggs, plus one cowbird egg just ready to hatch, on 11 June (S.D. Bailey unpublished 1981). In the south, yellow-throateds were feeding a fledgling cowbird on 16 June and a stub-tailed vireo on 12 August. Friedmann (1963) noted that this species is a frequent victim of the cowbird.

The longevity of a yellow-throated vireo banded and recovered in northeastern Illinois was 5 years and 11 months (Kennard 1975). As the bird was an 'adult' (AHY) when banded in June 1968, it was at least several months older than the age indicated.

We have noted that yellow-throated vireos seen after 20 August in central and southern Illinois appear to be in fresh plumage. Gault (unpublished 1897), on the other hand, observed one in northern Illinois that was in heavy molt on 22 August. Adult males killed on 17 and 27 September at central Illinois television towers were still in molt, and an immature killed on 1 October was in extensive molt.

Fall Migration

As is typical of southern-ranging species, fall counts of yellow-throated vireos tend to be low (Fig. 15, Table 6). We saw 1.6 in spring to 1.0 in fall in the north, 1.4 to 1.0 in the central region (1.6 to 1.0 in the census transects), and 7.0 to 1.0 in the south (2.4 to 1.0 in the transects). Dreuth (Clark & Nice 1950) at Chicago saw yellow-throated vireos an equal number of times (14) in spring and fall. Of nine birds aged from the tower kills, five were adults and four were immature.

We saw at least twice as many yellow-throated vireos on the western side of the state as on the east in both central and southern Illinois in both spring and fall.

As is also typical of the more southern-ranging species, yellow-throated vireos are not represented in television tower kills in large numbers—43 (known to us) have been picked up in fall from 1957 through 1979, mainly in central Illinois. The moderate numbers also reflect the fact that the total population of yellow-throateds is not very large. Kills of this species appear to come late (late September–early October) by comparison with the field counts (peak numbers in early September, Fig. 15). These results are partly a matter of most towers being examined late in the season (Graber et al. 1983) but may also mean that we missed the later migrants, and or that kill-inducing weather is more prevalent later.

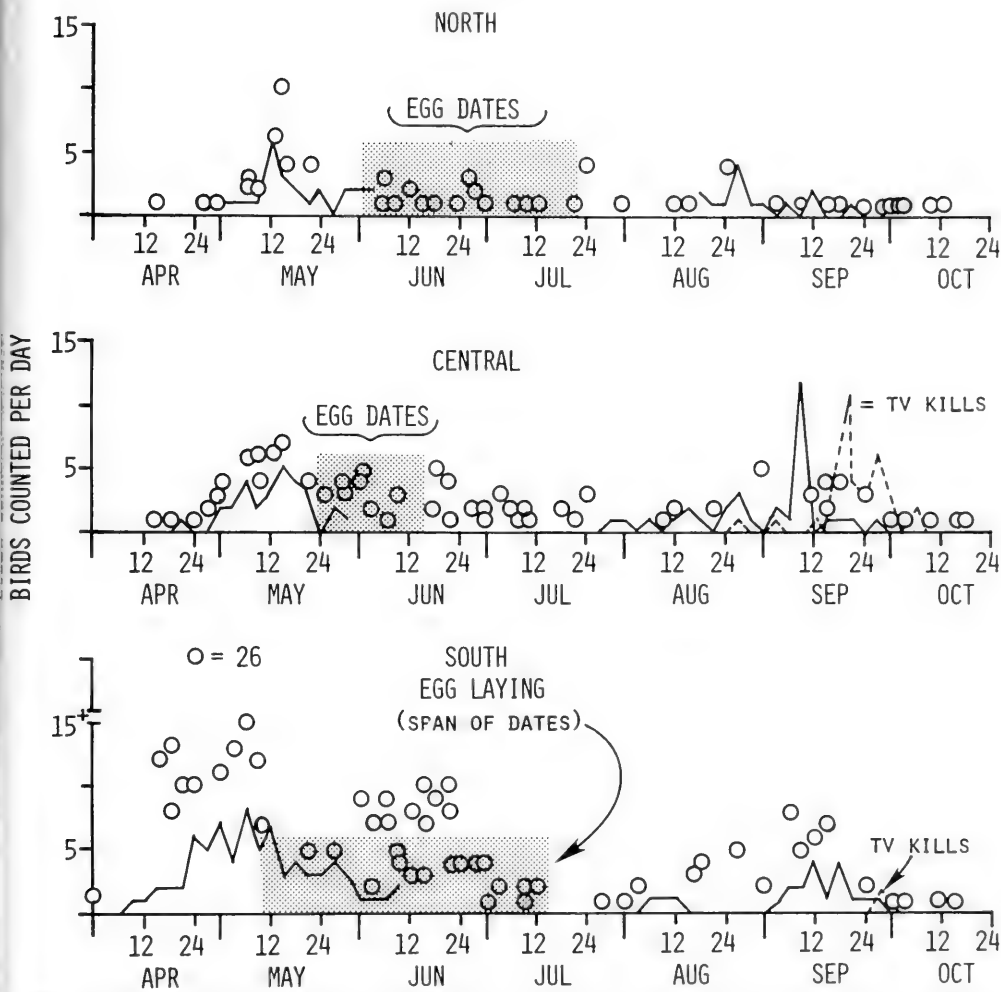

Fig. 15.—Egg-laying and migration seasons of the yellow-throated vireo in different regions of Illinois (see Fig. 1 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which eggs or laying have been reported. Dash lines show numbers killed at television towers during fall migration.

A bird killed at a Springfield TV tower on 26 August implies that the migration had started by that date. One seen at Charleston on 16 November (Kleen 1975a) was exceptionally late by comparison with other "last-seen" records, i.e., mid-October in the north (Woodruff 1907), 16 and 17 October in the central region (Kleen 1976a, 1982), and 15 October in the south (Ridgway 1874).

Food

In typical vireo fashion, the yellow-throateds feed heavily on Lepidoptera, but take more hemipterans than most vireos and less vegetable food (Chapin 1925).

In stomachs of three Illinois specimens Forbes (1878) found three Lepidoptera (one adult, two larvae), two beetles, and a fly. In our miscellaneous notes are two records of yellow-throated vireos eating adult *Catocala* moths after having removed the wings and one record of a bird eating a hairy caterpillar. Frank Smith (unpublished 1919) saw a bird of this species eat a butterfly (*Vanessa*?).

TABLE 6.—Spring and fall population densities of the yellow-throated vireo in Illinois (1979–1981).

Season and Habitat	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 40.5 ha	
				Maximum	Mean
Spring (9 April–31 May)					
Mature bottomland forest	Piatt (C)	9	186	2.3	0.7
Mature bottomland forest	Johnson (S)	20	416	9.5	3.5
Mature upland forest	Piatt (C)	13	279	9.2	1.3
Mature upland forest	Pope (S)	21	433	3.9	0.9
Forest edge and shrub	Piatt (C)	10	203	9.0	1.2
Forest edge and shrub	Pope (S)	17	337		0
Loblolly pines	Pope (S)	10	179		0
Fall (1 August–29 September)					
Mature bottomland forest	Piatt (C)	17	343	6.3	1.4
Mature bottomland forest	Johnson (S)	18	379	5.7	1.8
Mature upland forest	Piatt (C)	21	409	4.2	0.6
Mature upland forest	Pope (S)	15	326	1.9	0.2
Forest edge and shrub	Piatt (C)	20	411	4.0	0.3
Forest edge and shrub	Pope (S)	17	351		0
Loblolly pines (1979–1980 only)	Pope (S)	9	159		0

TABLE 7.—Breeding populations of the yellow-throated vireo in various Illinois habitats.

Habitat	Birds per 40.5 ha	Years	County or Region	Hectares Censused	Type of Census	Reference
Forest (all types, including edge)	0–1 (avg 0.5)	1957–1958	Central	87[a]	Strip	Graber & Graber 1963
Forest (all types, including edge)	2–3 (avg 2.4)	1957–1958	South	138	Strip	Graber & Graber 1963
Floodplain forest	6	1948	Sangamon (C)	31	Map	Snyder et al. 1948
Floodplain forest	0–16[b] (avg 5.6)	1949–1951, 1963, 1967	Piatt (C)	10	Map	Kendeigh 1982
Bottomland forest	0–1.84 (avg 0.4)	1978–1981	Central	193	Strip	This paper
Bottomland forest	0–5.8 (avg 1.1)	1973–1981	South	1,129	Strip	This paper
Upland forest	0–25.8[b] (avg 10.2)	1949–1951, 1962, 1963, 1967	Piatt (C)	13	Map	Kendeigh 1982
Upland forest	0–2.09 (avg 1.0)	1978–1981	Central	123	Strip	This paper
Upland forest	0–7.6 (avg 1.2)	1974–1981	South	623	Strip	This paper
Oak-maple forest	0–3.1 (avg 0.8)	1927–1976 (44 years)	Champaign (C)	24	Map	Kendeigh 1982

[a]Strip censuses calculated as cumulative hectares.
[b]Based on data in table of Appendix 3 of reference.

Specimen Data

Ridgway (1904) noted that yellow-throated vireos from the Mississippi Valley were smaller than those from the Atlantic coast. No races are recognized (American Ornithologists' Union 1957).

Gross weights of yellow-throated vireos killed 17 September–1 October were, for two adult males, 18.9 and 19.6 g; for one adult female, 18.4 g; and for three immature females, 17.8, 20.0, and 20.5 g. The heavy immatures were very fat (4 on a scale of 0–5); the rest were only moderately fat (2–3).

Fig. 16.—Breeding records of the yellow-throated vireo in Illinois.

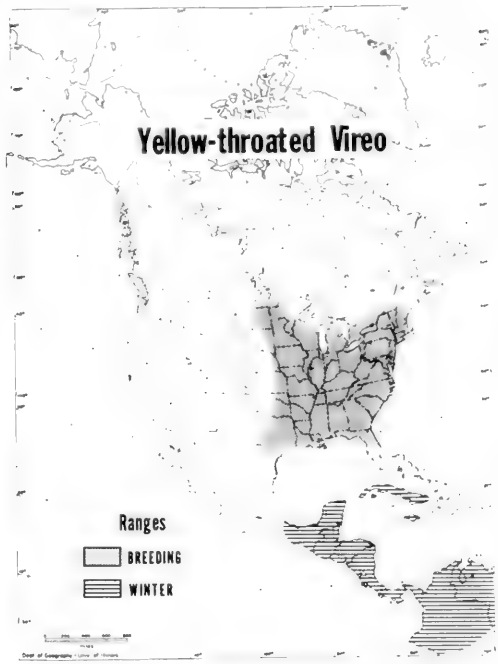

Fig. 17.—General distribution of the yellow-throated vireo

WARBLING VIREO

(Vireo gilvus)

Spring Migration

The earliest reports of warbling vireos in Illinois were 6 and 10 April in the south (Cooke 1909; Kleen 1974b), 15 and 16 April in the central region (Cooke 1885; Campbell unpublished 1972; Bohlen unpublished 1977; Fig. 18), and 23 and 26 April in the north (Kleen 1979a, 1981b). At least in central and southern Illinois, numbers of warbling vireos differed consistently between the western side (from the Illinois River west) and the eastern side of the state (Fig. 18). Peak numbers have been seen 29 April–18 May in the south (west, 23–33 per day; east, 8–10 per day), 29 April–26 May in the central region (west, 26–36 per day; east, 6–10 per day), and 11 May–3 June in the north (west, 13–18 per day). Comparable data are lacking for the northeast, though Dreuth apparently did not find large numbers of warbling vireos at Chicago (Clark & Nice 1950). A special comparative study is needed for the Illinois and Mississippi valleys, but it is our impression that the Illinois had higher numbers of warbling vireos.

In east-central Illinois the counts of warbling vireos by Frank Smith and his students (1903–1925) were similar to our more recent counts.

Highest spring densities were in bottomland forest in the south and in forest edge and shrub in the central region (Table 8). In the south spring densities were about three to four times the June densities (Table 9), but even so, the total number of birds passing through the area would not be large.

Distribution

Much of the extensive range north and west of Illinois—west of the great plains (Fig. 19)—has forms of the warbling vireo that do not occur in Illinois. The Illinois range (Fig. 20) is still incompletely known, but the species probably nests in every township in the state. In addition to records plotted in Fig. 20, there are breeding records for unspecified localities in these counties: Putnam (Hess unpublished 1905); Knox and Marshall (H.M. Holland unpublished 1950, 1957); Whiteside (Thompson 1958); and Richland, Adams, Schuyler, and Shelby (Kleen 1977–1978, 1978–1979; Greenberg 1982).

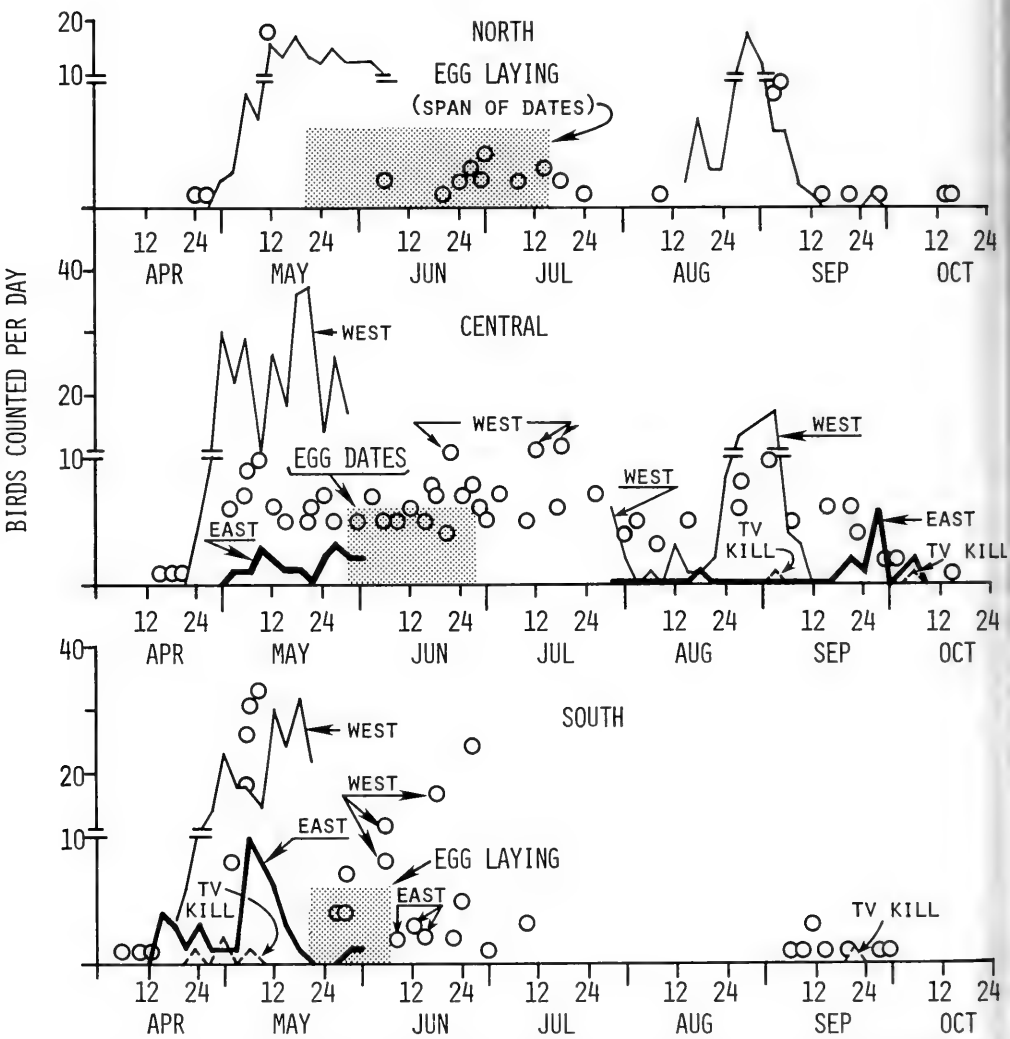

Fig. 18.—Egg-laying and migration seasons of the warbling vireo in different regions of Illinois (see Fig. 4 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which eggs or laying have been recorded. Dash lines show numbers killed at television towers during migration.

Nesting Habitats and Populations

The warbling vireo is tolerant of humans (Ridgway 1887; Hess 1910; Schantz 1931), and the highest density recorded for the species in Illinois (79 per 40 ha) was in woodland modified by the presence of human housing (Beecher 1942; Table 9). Note, however, that the habitat sample was small, as were those in studies by Fawks (1937, 1938) and Karr (1968). Data from small census plots (under 15 ha) are not comparable with figures for large areas (Table 9). Though warbling vireos breed even in urban residential habitat, the densities are low, as they are generally for this species wherever it occurs (Table 9), at least in recent times. Hess (1910) noted that the warbling vireo did not occupy forest habitat in Champaign County but did in the Illinois Valley (see also Barnes 1890 and Gates 1911). The highest densities

TABLE 8.—Spring population densities of the warbling vireo in Illinois (1979–1981).

Season	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 10.5 ha	
				Maximum	Mean
Spring (27 April–18 May)					
Mature bottomland forest	Piatt (C)	3	62	2.3	0.7
Mature bottomland forest	Johnson (S)	9	183	9.2	1.8
Mature upland forest	Piatt (C)	7	128		0
Mature upland forest	Pope (S)	8	161	1.9	0.2
Forest edge and shrub	Piatt (C)	5	104	6.0	1.9
Forest edge and shrub	Pope (S)	7	138		0
Loblolly pines	Pope (S)	4	70		0

we have recorded (3–11 per 40 ha) were in the Illinois Valley, where the forest is much dissected by streams and lagoons. Ridgway (1874) considered the warbling vireo a bottomland forest species in the Wabash Valley, but even then it was probably confined mainly to the edges or openings, such as those along streams (Ridgway 1889; Widmann 1907). On the upper Mississippi River, Hodges (1951) found 31–44 pairs of warbling vireos on Credit Island. If the whole 400-acre island be considered as habitat, this number translates to 15–22 birds per 40 ha, a high density for this species on a large area, and points out the possible importance of parkland as habitat.

Older references (Barnes 1890; Ridgway 1889; and others) indicated high populations of the warbling vireo in Illinois, but Ridgway (1915b) noted a severe

TABLE 9.—Breeding populations of the warbling vireo in various Illinois habitats.

Habitat	Birds per 10.5 ha	Years	County or Region	Hectares Censused	Type of Census	Reference
Urban residential	1	1958	North	65[a]	Strip	Graber & Graber 1963
Urban residential	9	1958	South	10	Strip	Graber & Graber 1963
Urban residential	0–+[b]	1976–1977	South	139	Strip	This paper
Modified woodland	79.5	1937	Lake (N)	11	Nest	Beecher 1942
Forest (all types, including edge)	0–1 (avg 0.5)	1957–1958	Central	87	Strip	Graber & Graber 1963
Forest (all types, including edge)	0–3 (avg 1.7)	1907, 1909	South	21	Strip	Graber & Graber 1963
Floodplain forest	6	1948	Sangamon (C)	31	Map	Snyder et al. 1948
Floodplain forest	52	1966	Vermilion (C)	6	Map	Karr 1968
Bottomland forest	0–11.2 (avg 1.5)	1978–1981	Central	193	Strip	This paper
Bottomland forest	0–2.5 (avg 0.5)	1973–1981	South	1,129	Strip	This paper
Second growth hardwood	13.3–26.7 (avg 20.0)	1937–1938	Rock Island (N)	6	Map	Fawks 1937, 1938
Cutover upland oak-hickory forest	0–4.1 (avg 1.0)	1911–1912 1914, 1918	Sangamon (C)	20	Map	Robertson 1911, 1912, 1914; Robertson & Snyder 1918
Shrub, including edge shrub	0–4 (avg 2.3)	1957–1958	South	52	Strip	Graber & Graber 1963
Late shrub	21	1966	Vermilion (C)	9	Map	Karr 1968
Orchard grass, tall fescue meadow[c]	+	1980	McLean (C)	12	Map	Birkenholz 1980

[a]Strip census calculated as cumulative hectares.
[b]+ = less than one bird per 10.5 ha.
[c]This meadow had a small stream with two large oaks at one end of it and woodland nearby.

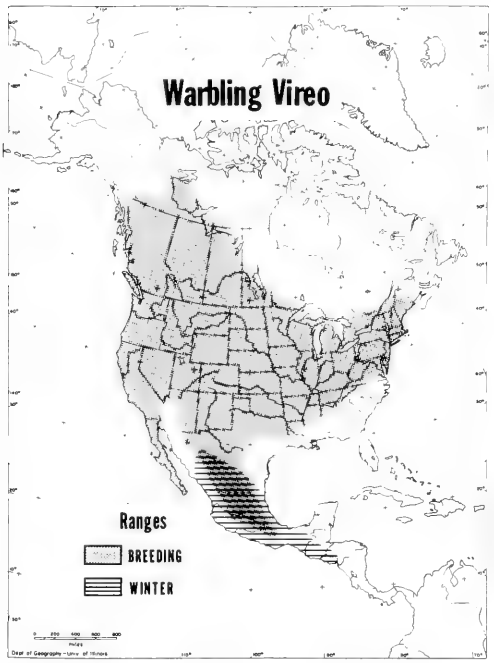

Fig. 19.—General distribution of the warbling vireo.

drop in the population. The only comparative data available are from the cross-country censuses for forest in the southern and central regions of the state. Densities for the habitat in 1907–1909 were: south, 1.7 birds per 40 ha; central, 0; and for 1957–1958: south, 0; and central, 0.5 bird per 40 ha. The figures do not indicate a major change in numbers of warbling vireos, though possibly some loss in the south since 1909.

Plant species that have been particularly associated with the warbling vireo were large silver maples (Ridgway 1889), maples in town and apples on farms (Hess 1910), and cottonwoods and willows (Swink 1976). Of 44 plants identified as nest sites of warbling vireos, mainly in northern and central Illinois, 11 were maples (9 soft or silver, 1 sugar, 1 box elder), 8 cottonwoods (plus 1 unspecified poplar), 5 oaks (3 white), 5 hackberries, 3 apples, 3 willows, 2 sycamores, and 1 each of birch, cherry, American elm, hickory, pear, and walnut. The most commonly used trees are primarily bottomland species. In the Illinois Valley, where warbling vireos were generally most numerous, one tree species—silver maple (*Acer saccharinum*)—was the overwhelming dominant. The presence of fruit trees in the list suggests that orchards have provided habitat for the warbling vireo, but the transect censuses revealed none in the orchard habitats sampled (Graber & Graber 1963).

Nest heights ranged from 5 to 60 feet (1.5–18.3 m), with a mean of 26.6 feet (8.1 m, n = 34) and modes at

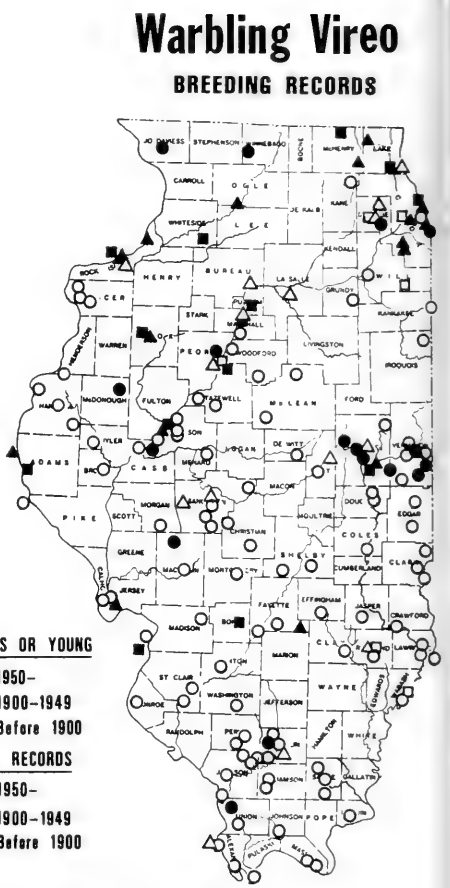

Fig. 20.—Breeding records of the warbling vireo in Illinois.

20–25 feet (6–8 m) and 35–40 feet (11–12 m).

On strip-mined land Brewer (1958) found warbling vireos in nearly all of the recovery stages, including young growth (10–13 years).

There are no Illinois data on territory size of the warbling vireo, and probably because of the difficulty of reaching most nests, there are essentially no data on the nesting cycle.

Widmann (1907) said that at St. Louis the warbling vireo's song could be heard from April to 20 September with a brief pause in August. Even more than the other species, this vireo is well known for its song, its persistence in singing, its singing at the nest (Elliott 1901; Schantz 1931), and even for its singing at night (Eifrig 1915). Farwell (1919) described the song as a lovely smooth flowing warble, meandering in rhythm, unlike the energetic notes of the red-eye. A commonly heard

call note—"frit" or "frut"—sounds something like a call of the ruby-crowned kinglet. Warbling vireos also scold a lot—a harsh sustained yammering—in the vicinity of their nests.

Cooke & Widmann (1884) noted mating in this species by 29 April at St. Louis. Data on the nest, its structure, and the time required for building are lacking for Illinois populations, though Cooke (1888b) described an aberrant nest of this species. A nest in extreme northern Illinois was complete by 1 May (McKinney 1966). The nest is much like those of other vireos (Fig. 21).

The egg-laying season extends from at least 20 May to 15 July in northern Illinois (Fig. 18). Data for the other regions are more fragmentary. In a May–July sample of 19 nests—mainly from northern and central Illinois—clutches were: five eggs, 1; four eggs, 14; three eggs, 4 (mean clutch, 3.8 eggs). None contained cowbird eggs. Parasitism of warbling vireo nests has been reported in Illinois by Friedmann (1963), who considered the species to be a frequent host of the cowbird. Poling (1889) stated that in a "large number" of warbling vireo sets from the Quincy area, three had cowbird eggs—presumably a much lower parasitism rate than in the red-eyed vireo (also see under red-eyed vireo). Data on nesting success and productivity are lacking for all populations and habitats of the warbling vireo. Predation on a warbling vireo nest by a bull snake was reported by Cooke (1888b).

We have seen warbling vireos that appeared to be in fresh plumage as early as 11 August in central Illinois.

Fall Migration

The onset of the fall migration of warbling vireos is difficult to discern because of the presence of local breeders. In the south, Nelson (1877) saw no warbling vireos until 27 August, after which they became common. The statement could refer to an influx of migrants, or merely to the resurgence of song (i.e., increased conspicuousness) in the local breeding population. Our counts in central and northern Illinois show a similar pattern—a striking increase in late August (Fig. 18)—and are subject to the same interpretations. A warbling vireo killed at a central Illinois television tower on 2 September indicates active migration by at least that date.

Peak numbers of warbling vireos were seen 25 August–28 September in central Illinois (6–17 per day) and 18 August–5 September in the north (6–18 per day, Fig. 18). For reasons unknown, few warbling vireos have been detected in southern Illinois in fall (Fig. 18). Nelson's (1877) reference to their being common at Mt. Carmel in the fall of 1875 cannot be interpreted numerically.

Fig. 21.—The nest of a warbling vireo 7.5 m high in an American elm (*Ulmus americana*). Photo taken 14 June 1984 at Rend Lake. Note the juvenile (on the edge of the nest) just ready to fledge.

In northwestern Illinois, Schafer (1917–1918) last saw presumed locally breeding warbling vireos between 5 and 14 September. The latest records were 14 and 15 October in the north (Boulton & Beecher 1939; Clark & Nice 1950), where October records are very few; 15 October in the central region (Bohlen 1978), where the latest television tower kill of this species was 6 October; and 27 and 30 September in the south (Cooke 1909; Kleen 1981a), where the latest tower kills were 21 and 22 September. Warbling vireos appear to be rare as casualties at Illinois television towers (Fig. 18).

The ratio of counts—spring to fall—was 2.4 to 1.0 in northern Illinois and 4.8 to 1.0 in the central region (none was seen in the fall census transects). In both Dreuth's counts at Chicago (Clark & Nice 1950), and Petersen's banding record at Davenport, Iowa (Dinsmore et al. 1984), the ratios strongly favored spring also. Whether warbling vireos are just very difficult to detect in fall, or are absent for the most part, remains to be determined.

Food

When Forbes (1883) examined three spring specimens of warbling vireos from an area with cankerworm (Lepidoptera) infestation, he found the stomach contents to be 44 percent cankerworms, 35 percent other caterpillars, and 15 percent Coleoptera, of which about one-third were larvae of Carabidae. In general, warbling vireos feed heavily on Lepidoptera (Chapin 1925). In fall, especially, they also take wild fruit, e.g., elderberries (Ridgway 1915a) and pokeberries, though Chapin's study indicates that vegetable food is taken in small quantities compared with that consumed by the red-eye. Holcombe & Yeomans (1938) observed a warbling vireo feed on larvae extracted from oak leaf blisters.

Only the nominate race (*V. g. gilvus*) has been recorded, or is to be expected, in Illinois (Ridgway 1904).

PHILADELPHIA VIREO

(Vireo philadelphicus)

Spring Migration

The earliest reports of the Philadelphia vireo in Illinois were 20 April in the south (Ridgway 1874, 1889), 27 April in the central region (M. Campbell unpublished 1983), and 3–4 May in the north (Fig. 22; Ford 1956). Peak numbers have been seen 5–12 May in the south (2–3 per day), 13–24 May in the central region (4–9 per day), and 10 May–1 June in the north (3–8 per day) (Fig. 22). Nelson (see Cory 1909) referred to 12 specimens per hour at Waukegan about 20 May. The latest spring records were 4 and 8 June in central and northern Illinois (H.D. Bohlen unpublished 1976; Ford 1956) but strangely early—22 May—in the south, where later records will surely turn up. Spring densities were also low in the south (Table 10), but whether this paucity is a matter of the "dilution" of the population in large forest acreage or is related in some way to migration route remains to be determined. Philadelphia vireos were more numerous on the eastern than on the western side of the state both in the central and southern regions. They were found in all woody habitats in the central region, but in the south were absent from pines (*Pinus taeda*) and upland forest (Table 10), though these absences may be spurious in view of the generally low numbers everywhere in the south. Forest edge and shrub appeared to be the preferred habitat in both central and south. Swink (1976) at Morton Arboretum and Widmann (1907) in Missouri noted that Philadelphia vireos preferred thickets along streams.

Philadelphia vireos sing during their spring sojourn even in southern Illinois, but the song is soft and does not greatly increase the species' conspicuousness. Dwight (1897) described the song as softer, sweeter, and slower (22–36 notes per minute vs 50–70) than the red-eye's song. Farwell (1919) thought the song less monotonous than the red-eye's song.

All references to the breeding of the Philadelphia vireo in Illinois (Brewster 1880; Ridgway 1889; Dwight 1897; Gault 1901a; and others) probably refer to E.W. Nelson's report of two pairs in dense thicket on Mazon Creek on 1 July 1874 (Cory 1909). This record—if true—would have been far south of the present breeding range (Fig. 23). Strumberg's (1879) reference to eggs of the Philadelphia almost certainly refers to a traded set, not to a local (Galesburg) collection.

Fall Migration

By August, Philadelphia vireos are coming back south and have reached the northern region (Davenport) by at least 14 August (Kleen 1978), the central region by 21 August (Kleen 1979c), and the south by 16 August (Kleen 1977). The earliest television tower casualties were found on 29 August at Orion (northwestern Illinois) and 2 September in east-central Illinois (Seets & Bohlen 1977). Peak numbers of Philadelphia vireos have been seen during the period 1–27 September in the northern (four to eight per day) and central (five to nine per day) regions, but in the south no more than one to two per day have been seen in fall (Fig. 22). Ridgway (1874, 1889) called it common or abundant, but gave no numbers; the comment may reflect annual variation—i.e., a particularly high year. Both the field counts and our censuses, as well as tower-kill data, indicate that the species is less common in the south than in the central or northern regions (Fig. 22, Table 10). Philadelphias frequented all woody habitats in the central region, where forest edge and shrub was most favored. In the south they were in bottomland forest (Table 10).

The latest reports of Philadelphia vireos were 12 and 22 October in the north (Blake & Smith 1942; Fawks 1968a; Bohlen 1978), 13 and 16 October in central Illinois (Kleen 1979b; H.D. Bohlen unpublished 1981) plus a straggler on 17 November at Charleston (Kleen 1980b), and 9 and 10 October in the south (Fig. 22).

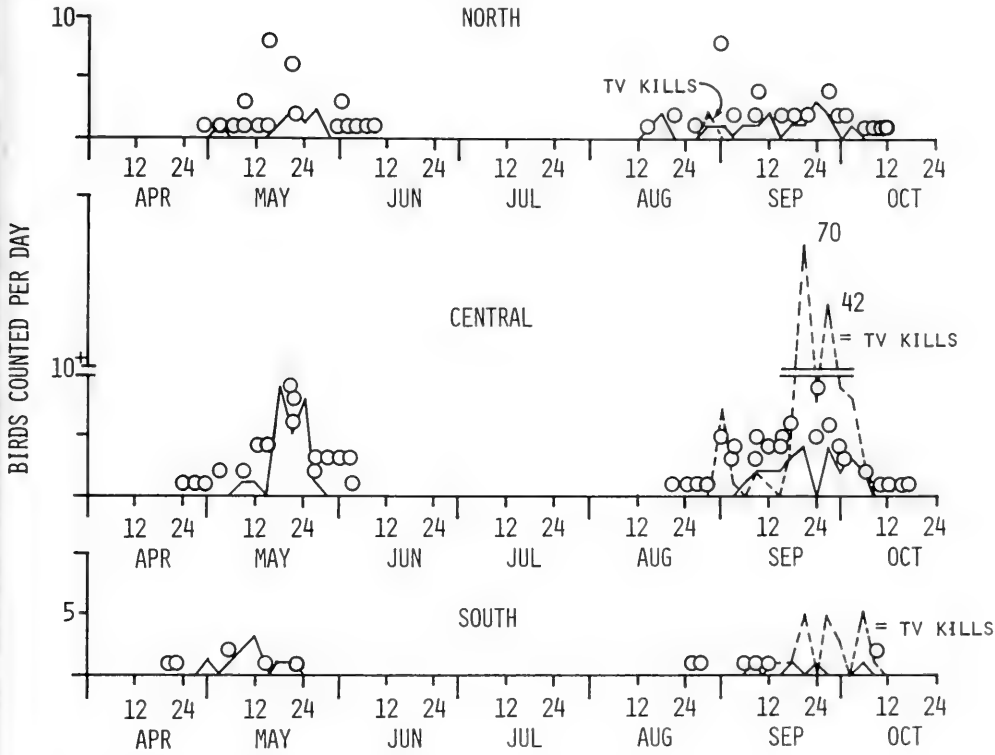

Fig. 22.—Migration seasons of the Philadelphia vireo in different regions of Illinois (see Fig. 4 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Dash lines show numbers killed at television towers during fall migration.

TABLE 10.—Spring and fall population densities of the Philadelphia vireo in Illinois (1979–1981)

Season and Habitat	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 10.5 ha	
				Maximum	Mean
Spring (9–24 May)					
Mature bottomland forest	Piatt (C)	6	125	9.2	3.2
Mature bottomland forest	Johnson (S)	2	41	2.4	1.0
Mature upland forest	Piatt (C)	7	159	2.0	0.5
Mature upland forest	Pope (S)	3	64		0
Forest edge and shrub	Piatt (C)	5	99	11.4	2.9
Forest edge and shrub	Pope (S)	4	74	2.5	1.1
Loblolly pines	Pope (S)	1	18		0
Fall (2 September–10 October)					
Mature bottomland forest	Piatt (C)	13	262	5.8	1.1
Mature bottomland forest	Johnson (S)	11	290	5.5	0.4
Mature upland forest	Piatt (C)	11	271	8.3	1.6
Mature upland forest	Pope (S)	11	231		0
Forest edge and shrub	Piatt (C)	15	299	10.6	2.6
Forest edge and shrub	Pope (S)	13	262		0
Loblolly pines (1979–1980 only)	Pope (S)	6	106		0

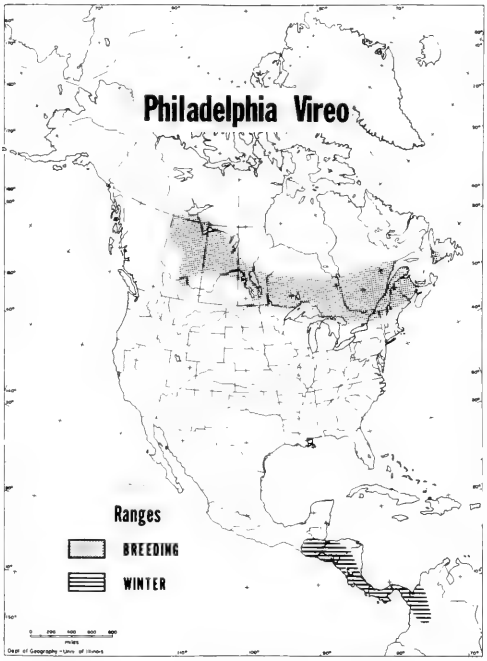

Fig. 23.—General distribution of the Philadelphia vireo.

The ratio of spring to fall counts was 1.0 to 2.6 in the northwest, 1.0 to 1.0 in the central region (1.0 to 2.0 in the census transects), and 4.3 to 1.0 in the south (1.0 to 1.0 in the transects). At Chicago, Dreuth saw Philadelphias with equal frequency, spring and fall (Clark & Nice 1950), and at Davenport, Petersen banded 1.0 in spring to 1.3 in fall (Dinsmore et al. 1984). In a sample of 39 Philadelphia vireos picked up 2 September–6 October 1957–1972 at central Illinois television towers, there was 1.0 adult to 1.2 immatures, the rough equivalent of 1 bird in spring to 2 in fall.

Our only observations on the food of the Philadelphia vireo were of a bird which—on 18 September—ate two fruits of the dogwood, *Cornus racemosa*, in quick succession, though the fruit was a bit large and difficult to swallow, and of another, on 1 October, which skillfully unrolled the leaf roll on a shingle oak and ate the larva it contained. Chapin (1925) found the diet included high levels of beetles as well as lepidopterans.

Specimen Data

An immature male killed on 2 September at the Fithian television tower still showed signs of the body molt. Ranges of gross weights (with mean and standard error) of Philadelphia vireos killed at central Illinois towers, 2 September–6 October 1957–1972 were, for six adult males, 12.7–15.9 g (13.48, 0.49); six immature males, 11.3–13.5 g (12.42, 0.32); six adult females, 10.6–13.1 g (12.0, 0.39); and six immature females, 11.3–16.7 g (13.40, 0.82). Brains of Philadelphia vireos were relatively heavier than brains of red-eyed vireos (Graber & Graber 1965).

RED-EYED VIREO

(Vireo olivaceus)

(Fig. 24 and cover)

Spring Migration

The earliest reports of red-eyed vireos in Illinois were: 9–12 April in the south (Fig. 25; Cooke 1883; Hanselmann 1963–1964, Peterjohn 1981), 19–20 April in the central region (Bohlen unpublished 1977, 1981; Cooke 1909), and 14 April in the north (Smith 1941). Cooke (1884a) considered the red-eye to be the slowest spring migrant in the Mississippi Valley. The inference is that red-eyes tend to stay longer at their landing sites than most species, but this behavior apparently has never been confirmed by observations of banded birds. Peak numbers of red-eyes have been seen 30 April–21 May in the south (29–42 per day), 10 May–2 June in the central region (30–60 per day), and 14 May–5 June in the north (15–28 per day) (Fig. 25). Cooke (1883) called the species common in the south on 12 April, an early date for the species to appear in numbers. The counts for the north represent primarily northwestern Illinois, and we would expect higher numbers in the northeast, where birds may be concentrated along the Lake Michigan shore. The passage of the last transients, especially in the north and central regions, may be obscured by the sizable breeding population in the area, but we suspect that the last females may not pass northern Illinois until late June in some years.

Twomey (1945) noted that red-eyes in spring at Trelease Woods (east-central) tended to stay in the forest interior, where counts were 35–40 birds per day, versus 10–15 for forest edge. Our data (Table 11) show the same preference by red-eyes in southern as well as central Illinois. Spring densities were higher in bottomland than upland forest in the south, but this "preference" was reversed in the central region (Table 11). Average spring densities ranged from about two times (upland forest, south) to about nine times (upland forest, central) average June densities in the same habitats (Tables 11 and 12). In all habitats combined there were 4.6 times as many red-eyes in May as in June, indicating a large transient population. For purposes of comparison, the ratio is from our transect censuses only. In the south, spring counts tended to be higher on the western side of the state (1.5 times) than on the east, but in central Illinois the pattern was reversed—1.0 (west) to 1.8 (east)—judging from dates with counts available for both sides (see also Fall Migration).

Fig. 24.—Red-eyed vireo at its nest, 4 June 1975 in Pope County. The cover plate [illegible]

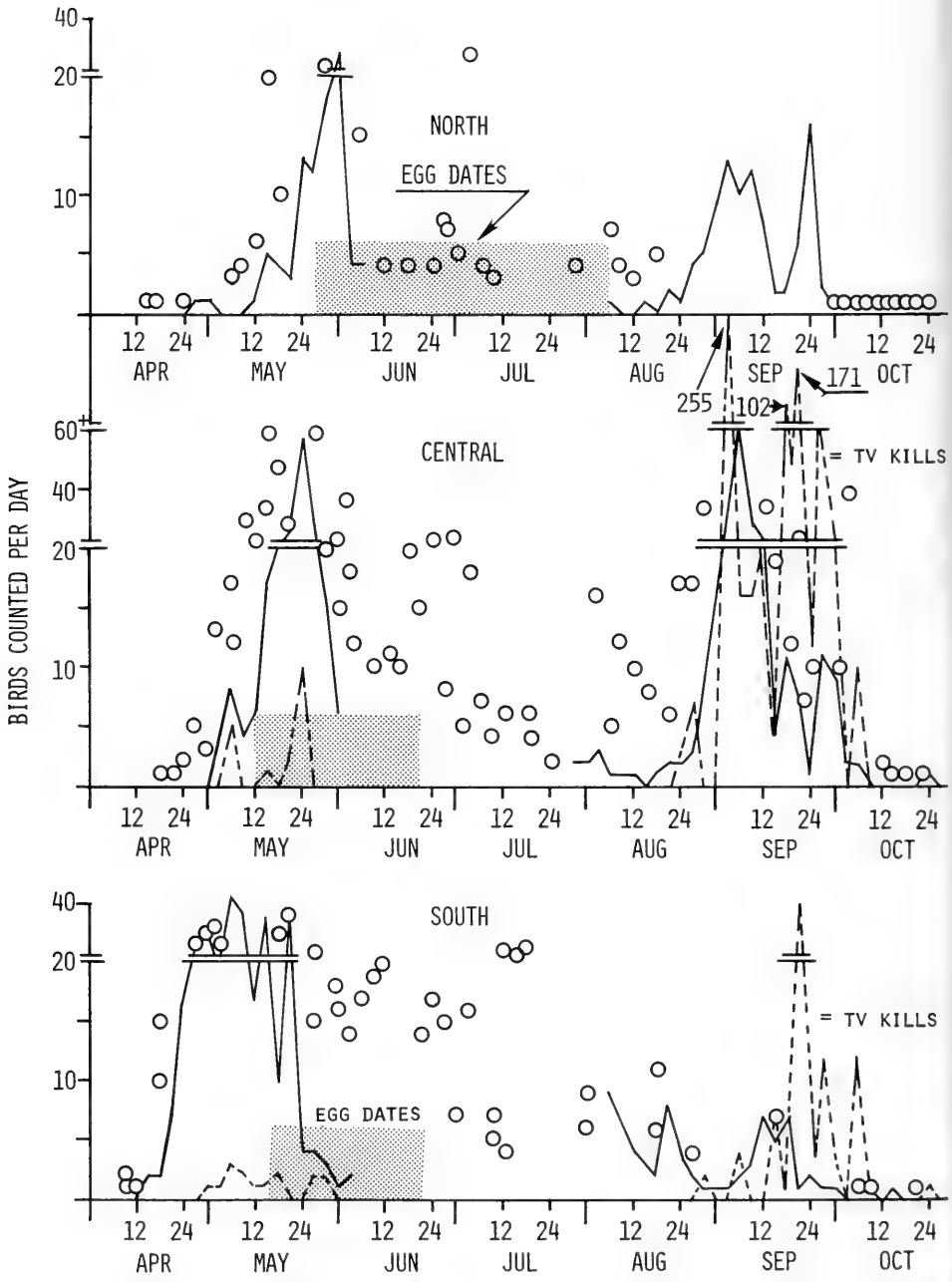

Fig. 25.—Egg-laying and migration seasons of the red-eyed vireo in different regions of Illinois (see Fig. 4 for regions). Spring and fall lines show the highest daily count of each 3 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Shaded areas show the span of dates during which eggs have been recorded. Dash lines show numbers killed at television towers during migration.

TABLE 11.—Spring and fall population densities of the red-eyed vireo in Illinois (1979–1981).

Season and Habitat	County or Region	Number of Censuses	Cumulative Hectares Censused	Birds per 10.5 ha	
				Maximum	Mean
Spring (9 April–31 May)					
Mature bottomland forest	Piatt (C)	8	166	11.8	21.4
Mature bottomland forest	Johnson (S)	20	416	11.2	12.9
Mature upland forest	Piatt (C)	12	259	69.3	30.3
Mature upland forest	Pope (S)	21	433	28.8	8.7
Forest edge and shrub	Piatt (C)	9	183	28.5	10.6
Forest edge and shrub	Pope (S)	17	337	8.0	1.8
Loblolly pines	Pope (S)	10	179	11.3	2.0
Fall (20 August–11 October)					
Mature bottomland forest	Piatt (C)	17	341	35.0	8.1
Mature bottomland forest	Johnson (S)	16	333	9.8	2.5
Mature upland forest	Piatt (C)	19	368	18.5	11.8
Mature upland forest	Pope (S)	15	327	5.5	0.7
Forest edge and shrub	Piatt (C)	20	399	47.8	13.6
Forest edge and shrub	Pope (S)	17	316	8.0	1.3
Loblolly pines (1979–1980 only)	Pope (S)	8	142		0

Distribution

The red-eyed vireo has an extensive range in North America (Fig. 26; Pitelka 1941) that includes both deciduous and coniferous forest areas. In Illinois the species surely nests in every county and probably in nearly every township. The absence of records for large areas of the state (Fig. 27) almost certainly indicates inadequate exploration in those areas. In addition to records plotted in Fig. 27, there are breeding records for unspecified localities in Piatt, Champaign (Goelitz 1917), Knox (Holland unpublished 1952), Peoria, Shelby, and Warren counties (Greenberg 1982).

Nesting Habitats and Populations

Red-eyed vireos have occupied a rather broad range of woods habitats in Illinois, including young stands (Brewer 1958) as well as extensive mature upland and bottomland forest (Table 12; Cahn & Hyde 1929). Red-eyes have also been found in a small grove in prairie (Birkenholz 1975), human residential areas (J. Ridgway 1923; R. Ridgway 1887, 1925b; Silloway 1894b; Roberts 1923; Beecher 1942), city parks (Ford 1915; Nice 1950, 1952), and an urban cemetery (Zimmerman & Steffen 1975). Populations in human residential areas are probably very low. Most of our censuses in towns have been negative for the species, and even in Ridgway's (1887) time red-eyes were on the outskirts of town and sparse even there. In southern Illinois, where we censused a total of 441 acres (178 ha) of residential habitat in 1958, 1976, and 1977, no red-eyed vireo was detected in the transect. The species may be more likely to occur in northern towns, where we found a density of one bird per 40 ha in 1958 (Table 12). Even in forest proper, densities appear to be higher in the north than in the central and south (Table 12).

Forest edge is also poor habitat, having consistently low densities of red-eyed vireos (Table 12). Kendeigh (1982) showed that red-eyed vireo numbers decreased when forest canopy was disrupted. In recovering strip-mined land, where Brewer (1958) studied plots ranging in age from 6 to 24 years after stripping, he found red-eyes only in the oldest plots (21–24 years), where tree crowns were apparently sufficiently developed for the species.

The highest average densities of red-eyed vireos on record (31–38 birds per 40.5 ha) were in upland forest of east-central Illinois, bottomland forest having slightly lower numbers (Table 12). Densities for large areas censused by transect census in June *only* were much below those in which map censuses were applied. The map censuses generally contained spring (April–May) data, possibly including some transients. Our densities for *spring* are more nearly comparable to the map census results (Tables 11 and 12). Our censuses also show higher breeding densities in bottomland than in upland forest in both southern and central Illinois (Table 12). Gates (1911) considered the red-eyed vireo a dominant species of bottomland forest on the Illinois River. Swink (1976) felt that the preferred habitat at Morton Arboretum was woods of mature white oak and sugar maple.

Of 45 plants identified as nest sites of red-eyed vireos in all regions of Illinois, 19 were maples, including at least 10 sugar maples; 5 were ironwoods; 4 hackberries (*Celtis* sp); 3 white ashes (*Fraxinus americana*); 2 lindens (*Tilia americana*); 2 "oaks"; and 1 each of sassafras, black locust (*Robinia pseudoacacia*), elm, sycamore (*Platanus occidentalis*), grape (*Vitis* sp), honeysuckle, witch hazel, choke cherry, blackberry, and redbud. Original citations for some of these plants lack scientific names. The high percentage of sugar maples suggests a preference by red-eyes for mesic upland woods. Red-eyed vireo densities were not correlated with Importance (Y) of *Acer* or any other plant in the various forest tracts we studied (Graber et al. 1977, 1983), but the areas with lowest Y (0–2) for *Acer* also had the lowest densities of red-eyes.

Heights of 50 Illinois nests ranged from 2 to 45 feet (1–14 m), with modes at 6–10 feet (2–3 m) and 20 feet (6 m) and an overall average of 11.1 feet (3.4 m). The data probably underrepresent high nests.

TABLE 12.—Breeding populations of red-eyed vireos in various Illinois habitats.

Habitat	Birds per 40.5 ha	Years	County or Region	Hectares Censused	Type of Census	Reference
Urban residential	1	1958	North	65[a]	Strip	Graber & Graber 1963
Woods (unspecified)	19.2	1914–1923	Rock Island (N)	8–22		J.J. Schafer unpublished notes
Forest (all types, including edge)	11–14 (avg 12.4)	1957–1958	North	72	Strip	Graber & Graber 1963
Forest (all types, including edge)	3–7 (avg 5.1)	1957–1958	Central	87	Strip	Graber & Graber 1963
Forest (all types, including edge)	5–8 (6.7)	1907–1908	South	24	Strip	Graber & Graber 1963
Forest (all types, including edge)	7–8 (avg 7.6)	1957–1958	South	138	Strip	Graber & Graber 1963
Virgin floodplain forest	20	1948	Sangamon (C)	31	Map	Snyder et al. 1948
Virgin floodplain forest	24	1947	Piatt (C)	20	Map	Fawver 1947a
Floodplain forest	8–72 (avg 27.2)	1949–1951, 1963, 1967	Piatt (C)	10	Map	Kendeigh 1982
Bottomland forest	26	1966	Vermilion (C)	6	Map	Karr 1968
Bottomland forest	7.3–14.6 (avg 11.0)	1974, 1978	Willow Slough, Indiana	11	Map	Hopkins 1974, 1978
Mature bottomland forest	0–24.4 (avg 6.1)	1978–1981	Central	193	Strip	This paper
Grazed stream bottomland forest	22.6	1955	Macon (C)	21	Map	Chaniot & Kirby 1955
Mature bottomland forest	0–30 (avg 5.3)	1973–1981	South	1,129	Strip	This paper
Riparian oak-hickory forest	+[b]	1980	Wayne (S)	8	Map	Keener 1981b
Oak-maple forest	6.7–80.9 (avg 30.7)	1927–1976 (42 years)	Champaign (C)	24	Map	Kendeigh 1982
Upland forest	32.2–58.1 (avg 37.6)	1949–1951, 1962, 1964, 1966	Piatt (C)	13	Map	Kendeigh 1982
Upland oak-hickory forest	4.2	1967	Hancock (C)	10	Map	Franks & Martin 1967
Mature upland forest	0–6.3 (avg 3.3)	1978–1981	Central	123	Strip	This paper
Oak-hickory-maple forest	6.2–25 (avg 17.5)	1977–1981	McLean	13	Map	Birkenholz 1977, 1978, 1979, 1980, 1981
Mature upland forest	0–11.5 (avg 4.5)	1974–1981	South	623	Strip	This paper
Upland deciduous forest	13.2–26.3 (avg 19.7)	1977–1978	Jackson (S)	6	Map	Morrison & Peterjohn 1977; Morrison 1978
Second-growth hardwood	26.7	1937	Rock Island (N)	6	Map	Fawks 1937
Cutover upland oak-hickory forest	4.1–30.6 (avg 11.7)	1941–1942, 1944, 1948	Sangamon (C)	20	Map	Robertson 1941, 1942, 1944; Robertson & Snyder 1948
Abandoned farmland (shrub and forest edge)	0–6 (avg 0.3)	1953–1969 1971 (18 years)	Piatt (C)	24	Map	Kendeigh 1982
Shrub, including edge shrub	0–1 (avg 0.8)	1957–1958	South	52	Strip	Graber & Graber 1963
Pastures	1	1909	North	78	Strip	Graber & Graber 1963
Pastures	0–+	1907, 1909	Central	179	Strip	Graber & Graber 1963

[a]Strip censuses calculated as cumulative hectares.
[b]+ = less than one bird per 40.5 ha.

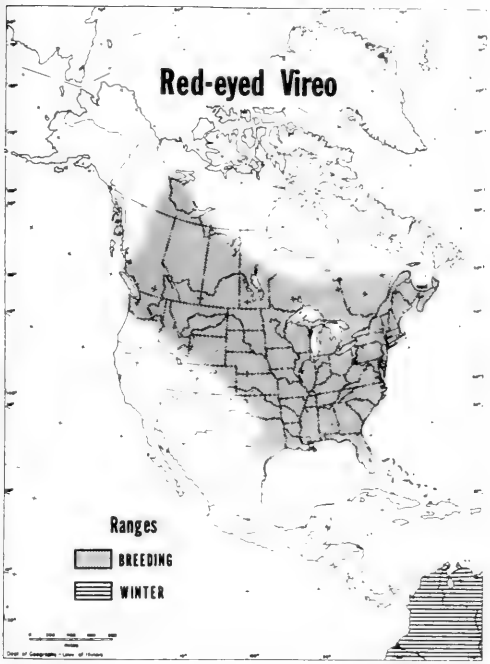

Fig. 26.—General distribution of the red-eyed vireo.

No particular trend is apparent in the available data on the question of whether or not the red-eyed vireo population is changing (Table 12). Ridgway (1889) considered it the most abundant woodland species. Eifrig (1937) thought the red-eye population was declining in Illinois because of cowbird depredations, but the case has not been proved.

Territories of red-eyed vireos were measured in two habitats in Piatt County in 1946. In virgin floodplain forest six territories averaged 3.1 acres (1.2 ha) (Fawver 1947a), and in upland forest four territories ranged in size from 0.7 to 2.5 acres (0.3–1.0 ha) and averaged 1.7 acres (0.7 ha) (Allison 1947). In mature bottomland forest in McLean County four territories (each year) ranged from 0.58 to 2.53 acres (0.2–1.0 ha), with a mean of 1.43 acre (0.6 ha) in 1950, and from 1.92 to 2.60 acres (0.8–1.0 ha), with a mean of 2.36 acres (0.95 ha) in 1951 (Calef 1953). Calef observed that territory size increased when the red-eye population decreased. Allison (1947) observed a red-eyed vireo whose territory was within the boundaries of a yellow-throated vireo's territory, the two species being entirely compatible. In a Chicago park a red-eyed vireo defended an area of about 0.7 acre (0.3 ha) from grackles, but defended 1.8 acre (0.7 ha) from another red-eyed vireo (Nice 1950).

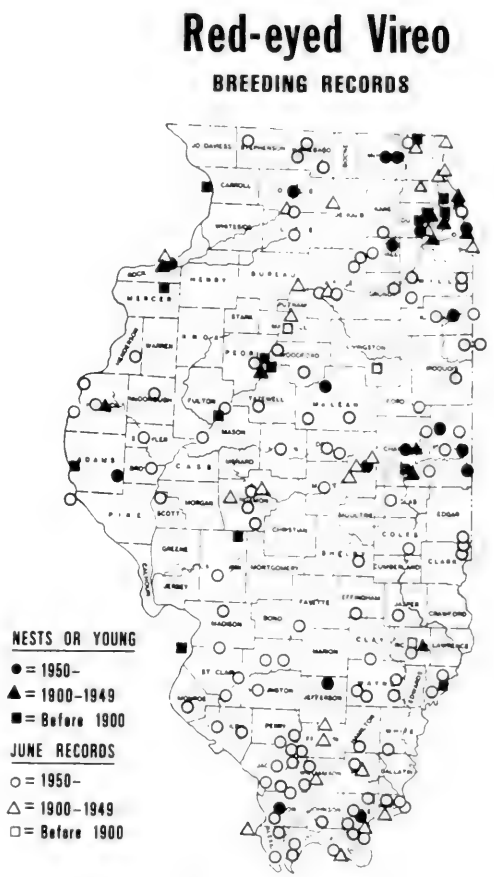

Fig. 27.—Breeding records of the red-eyed vireo in Illinois

Nesting Cycle

The red-eyed vireo is one of the most persistent singers, the male singing usually in the upper canopy even at midday of the hottest season (Widmann 1907; Twomey 1945). The song is a pretty series of somewhat questioning phrases, sometimes phoneticized: "Do you hear me? Do you see me? I am here . . . ," often continuing on and on with variations on the theme. Nice (1950) observed the rate of singing to be consistent for a particular male, but that it varied from male to male. At Chicago one male sang 57 times per minute, another 35 (Nice 1950). In east-central Illinois the main song period lasted until early August (Fawver 1947b). At St. Louis, Widmann (1907) noted that singing was interrupted 5–6 weeks in late summer—probably during the

molt. Our notes indicate that song ended in all regions finally during the last half of September and that birds were relatively quiet in July and early August. Another common vocalization is a grating scold note uttered over and over when intruders are near the nest.

Nest building activity by red-eyes may be seen nearly any time in summer, but in southern Illinois it occurs particularly during May. Even in the north many first nests are completed by 5 June. More coarse in structure than nests of the smaller vireos, the nest of the red-eye is a relatively shallower, wider bowl. Crone (1896) described one made of grass, spider web, and bits of hornet's nest. Nice (1950) observed that only the female brought material (shreds from a willow) during nest construction, though the male accompanied her on 15 of 16 trips she made in an hour. The female built with a weaving motion for periods of a few seconds to 2 minutes. Hess (1910) suggested that red-eyes build "extra" nests, based on the number of unoccupied nests he found, but the point needs verification.

The eggs are white lightly speckled with brown. The laying season extends from at least 12 May in central Illinois to at least as late as 5 August in the north (Fig. 25). A nest with four young on 15 May in central Illinois (Hess 1910) implies a laying date at least as early as 2–3 May (not plotted in Fig. 25)—probably exceptionally early for the species at that latitude, though earlier laying records can be expected in southern Illinois when the data are more complete.

In Canada, Lawrence (1953) determined the incubation period to be 12–14 days, most commonly 13. Incubation was by the female only. At Chicago attentive periods by the female ranged as high as 30 minutes. She was off the nest for periods of 7, 11, and 1 minute between attentive periods during the incubation phase, while the male defended the nest area—chasing grackles away 16 times in 80 minutes (Nice 1950).

The red-eye is a frequent victim of cowbird parasitism (Friedmann 1963), and clutch size depends very much on the amount of such interference (Table 13). In 12 nests studied by Twomey (1945) the clutch size of the red-eyed vireo averaged 3.25 (+ 1.08 cowbird eggs). Within historical times the parasitism rate in this species has been high (Crone 1896; Sanborn & Goelitz 1915). Poling (1889) found four of six nests parasitized. The red-eye is one vireo that can raise young of its own and cowbirds together. A Pope County nest that we observed fledged three vireos and one cowbird.

TABLE 13.—Clutch size in Illinois red-eyed vireos. Data represent all regions between 1884 and 1981.

Not Parasitized		Parasitized							
					Cowbird Eggs			
Clutches	Eggs	Clutches	Vireo Eggs		1	2	3	4
1	5	1	5	+	1	0	0	0
12	4	3	4	+	2	0	1	0
1	3	16	3	+	10	4	2	0
0	2	9	2	+	1	3	2	0
0	1	2	1	+	0	1	1	0
0	0	3	0	+	0	0	2	1
Total nests: 14		*34*						
Average vireo clutch: 4.0			*2.5*					
Average cowbird clutch: 0					*1.8*			

Lawrence (1953) found the duration of nestling life to be 10–11 days. At Chicago, Nice (1950) observed that both adults fed the young. When nestlings were 1–2 days old, the female brooded 40 minutes between 1000 and 1100 hours and brought food once, while the male brought food twice. The next day between 0630 and 0730 the male fed nestlings once, and the female fed them five times and brooded for 1–20 minutes after each feeding. In general, males did much less of the feeding of nestlings than did females (Lawrence 1953).

Cowbird parasitism has a strong influence on productivity in red-eyed vireo populations. Nesting success in parasitized nests was half or less that in unparasitized nests (Friedmann 1963). The 12 nests studied by Twomey (1945) produced, on average, 1.7 vireos and 0.8 cowbird per nest. Nine of his nests produced at least one vireo—a high rate of success. Calculations of success by the exposure method (Mayfield 1961, 1975) were not in use at that time. In a sample of 16 recent Illinois nests (all regions) only one (6 percent) fledged young—three vireos and one cowbird. Such a rate would be insufficient to support a population, and the sample may represent particularly vulnerable nests. Studies are needed for larger samples of nests over a period of years—nests that represent different habitats and all parts of the nesting season. Late nests (after June, i.e., after the cowbird laying season) may be more successful. Causes of nest failure are unknown on any quantitative basis. Nice's (1950) observations imply problems with avian predators. At least 3 nests of 48 for which partial histories are available were robbed of eggs or nestlings by blue jays (Mrs. W. Carroll unpublished 1964, 1967; M. Easterday unpublished 1978).

The long laying season (Fig. 25) may imply that red-eyes try for more than one brood, but verification from studies of banded birds is required. B.T. Gault (unpublished 1897, 1899) saw young still in the care of adult birds as late as 13–17 September in northeastern Illinois. Late nestings may merely reflect the large number of nest failures in this species.

We have seen red-eyed vireos in heavy molt on 11 August, as did Ferry (1907), and birds that appeared to be in fresh plumage, as well as some still molting, on 21 August in the south. In the north most appeared to be in fresh plumage by 27 August. At least five adult red-eyes from central Illinois television tower kills were still in molt (crown, breast, and wings) on 17 September. Another was still in worn plumage on 29 September.

Fall Migration

Tower-kill data indicate that the fall migration of red-eyed vireos is in progress at least as early as 24 August in central Illinois (Fig. 25). Musselman (1937) reported "a small flight" of red-eyes on 23 August at

Quincy. Red-eyes seen out of habitat by Gault (unpublished 1916) on 14 July at Glen Ellyn could have been either migrants or local breeders moving about. Peak numbers of red-eyes (9–16 per day) have been seen in northwestern Illinois, 1–24 September (Fig. 25; Brown 1968), but P.C. Petersen banded highest numbers at nearby Davenport in late August (Halmi 1977). In the central region peak numbers (17–65 per day) were seen 23 August–4 October, with high numbers of tower-killed birds between 2 September and 1 October. In the south highest numbers (7–11 per day) were seen 1 August–17 September, with highest numbers picked up at the towers 22 September–6 October (Fig. 25). Note that both the counts and tower kills were lower in the south than in the central region. Probably because of its extensive range and high populations north of Illinois, the red-eyed vireo is one of the commonest victims at television towers (Brewer & Ellis 1958)—at least 1,091 specimens having been picked up in central and southern Illinois since 1957. As only a few towers are checked, none on a regular daily basis, the total kill of red-eyes in the state is likely many times that number.

The last red-eyed vireos of the season were seen 19 and 24 October in the north (Boulton & Pitelka 1938b; Clark & Nice 1950; Kleen 1975a), 25 October and 9 November in the central region (Fig. 25; Bohlen unpublished 1975), with one straggler as late as 30 November (Kleen 1974a), and 21 and 24 October in the south (George 1968; tower specimen 1975).

A possible indication of the direction of fall migration comes from a red-eye banded near Manitowoc, Wisconsin, on 11 September 1966 and recovered dead at the Seymour, Illinois, tower (330 miles [531 km] south of banding site) on 21 September 1966.

Twomey (1945) noted that red-eyes made greater use of forest edge (versus interior) in fall than in spring, as did we in central Illinois (Table 11). Otherwise red-eyed vireo habitats in fall were similar to those used in spring, but with generally lower densities in fall. The ratio of our counts—spring to fall—was 1.1 to 1.0 in the northwest. At Chicago, Dreuth saw red-eyes with a frequency ratio of 1.0 to 1.6, and at Davenport, P.C. Petersen banded nearly twice as many red-eyes in fall as in spring. In the central region the ratio was 1.2 to 1.0 (1.0 to 1.0 in the census transects), but in the south it was a lopsided 5.6 to 1.0 (6.2 to 1.0 in the transects). The sharp difference in the south is possibly related to differences in migration route between spring and fall, but that theory needs verification. The matter is further complicated because of differences in the numbers of red-eyes seen on the eastern and western sides of the state. In the central region counts were not radically different (1.0 to 1.8) between west and east in *spring*, but in fall about four times more red-eyed vireos were seen in the east. This is a pattern seen in a number of migrant species (Graber et al. 1983).

The ratios of the spring-fall counts do not account for any productivity by red-eyes during the nesting season, though both Dreuth's counts (Clark & Nice 1950) and Petersen's banding data (Dinsmore et al. 1984) showed better fall ratios and would account for some production. Age ratios in our sample of 262 tower-killed birds also indicate some productivity, but with results differing early and late in the fall migration. In a sample of 196 red-eyes killed by 21 September (over the years), there were more adults (99) than immatures (97), 1.02 adults to 1.00 immature. In a sample (66) killed *after* 21 September over the years, there was 1.0 adult to 3.7 immatures, and the only October specimens (7) had a ratio of 1 adult to 6 immatures. Many birds of the year pass through the state late in the season. The age ratio in the overall sample (1.00 adult to 1.32 immatures) would be the hypothetical equivalent of about 1 bird in spring to 2.3 in fall.

Food

Rice's (1946) study of food remains in six red-eyed vireo stomachs, representing spring, summer, and fall specimens, showed Lepidoptera to be the most common food, especially in summer. Diptera and Coleoptera (in both spring and fall) were next in importance. A stomach examined by Forbes (1878) also contained Lepidoptera (larva). We have often seen red-eyes feed on caterpillars both in spring and fall. Red-eyes were the commonest avian predators on larvae of *Lithophane* sp and *Morrisonia distincta* during an irruption of these lepidopterans on silver maples in the Sangamon (and other river) bottoms in May 1979. Hulsberg (1917–1918) observed red-eyes feed on egg masses of the tussock moth, and at least once (15 September) we saw a red-eyed vireo eat a furry tussock larva. More often in fall we have seen red-eyes feeding on fruit, including elderberries (*Sambucus canadensis*)—see also Ridgway (1915a)—woodbine (*Parthenocissus quinquefolia*), black cherry (*Prunus serotina*), wild grape, pokeberries (*Phytolacca americana*), and multiflora rose (*Rosa*). We did not see the vireo swallow the rose hip, but the other fruits were swallowed—probably with difficulty—except for elderberry and woodbine. Because the fruit in a large head of elderberry may be difficult to reach, red-eyes sometimes flutter in front (below) the head and pick the fruit on the wing. Chapin (1925) found that up to 49 percent of the red-eye's food in October is vegetable—wild fruit—whereas through April–October, overall, about 85 percent of the food is made up of insects, with Lepidoptera predominating.

Specimen Data

Ridgway (1904) noted that red-eyed vireos from the Mississippi Valley were intermediate in size between smaller birds from the Atlantic coast and larger ones from the Rocky Mountains. No subspecies was recognized by the American Ornithologists' Union (1957).

Ranges of gross weights (with mean and standard error) of fresh specimens of red-eyed vireos killed at central Illinois television towers, 9 September–15 October, 1957–1972, were, for 20 adult males, 15.5–21.8 g (19.35, 0.38); 36 immature males, 16.8–24.7 g (19.52,

0.34); 28 adult females, 15.7–21.9 g (18.79, 0.24); and 32 immature females, 15.9–24.6 g (19.22, 0.35). Most of the specimens were moderately fat (2–3 on a scale of 0–5). Immatures were generally fatter than adults, and some immatures were extremely fat (5). The spring data—specimens killed 20–22 May—includes Hancock's (1888) specimens. For two males gross weights were 19.3 g (fat class 3) and 23.0 g; for four females 20.2 g (fat = 3), 20.8 g (fat = 3), 19.7 g, and 15.4 g. Brain weights of red-eyed vireos were given by Hancock (1888) and Graber & Graber (1965).

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