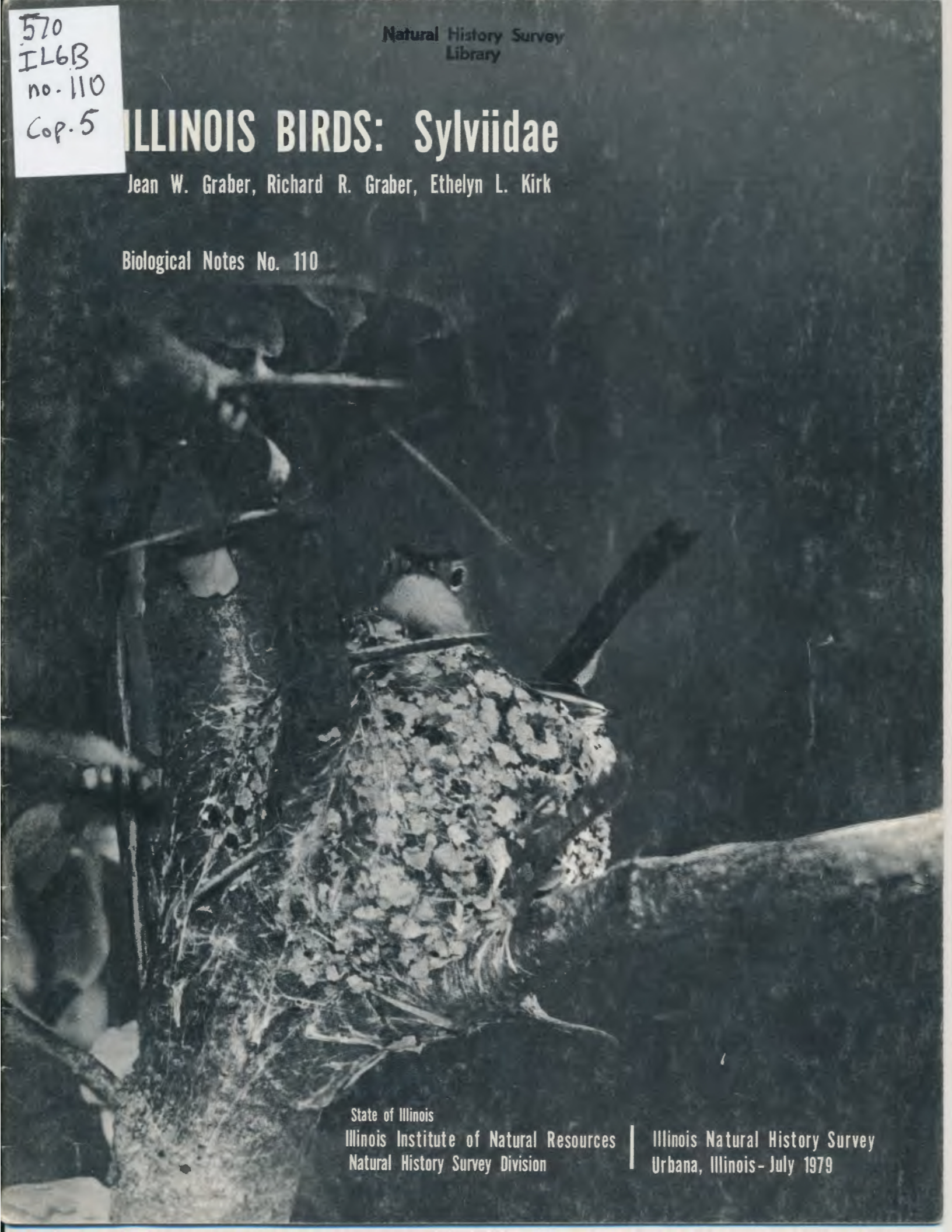
ILLINOIS BIRDS: Sylviidae

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

Biological Notes No. 110



State of Illinois
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Fig. 1.—Female blue-gray gnatcatcher working on its nest in Pope county, 29 April 1973.

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This is the eighth in a series of papers (e.g., Graber et al. 1978) designed especially to summarize the population data on Illinois birds. Our policies and procedures in collecting, analyzing, and presenting data have been outlined in the introductions of the papers, different aspects of the project being covered in each paper.

Anyone who attempts to census populations of birds is inevitably confronted with a problem that we might refer to as the "dilution factor," of which two important types warrant mention: (1) habitat-related dilution and (2) species-related dilution. The problem affects population measurements of all species, but may have some special significance to the sylviids because of their small size and relatively faint voices. The problem of dilution can perhaps best be explained by example, and concerns the difference in the detectability of one golden-crowned kinglet (an arboreal species) in one tree in the middle of an open field versus the dectectability of one kinglet in a forest (i.e., one tree versus several hundred). The bird is much more likely to be detected in the first instance. In Illinois this problem becomes particularly noteworthy between east-central and northeastern Illinois (areas with relatively few trees) on the one hand, and western and southern Illinois (areas with many trees) on the other. The consistently high counts of transients in east-central Illinois and the low counts for southern Illinois may have as much to do with the dilution factor as with actual population size.

Complicating the problem of habitat-related dilution is that of species-related dilution. It is probably easier to detect a kinglet that is by itself than to identify one in a large flock of other transients—say 200 birds of several species. In a sense each bird is competing for the observer's attention; the time required to identify one specimen reduces the time available for all the rest. Detectability of birds varies from species to species, its effect on a census is difficult to assess objectively, and thus, it is largely ignored.

An important question of concern to the conservation of wild populations is, what constitutes essential habitat? For most, if not all, populations the answer is unknown. Our few observations on the life cycle of the gnatcatcher relate to the species in upland habitat, where populations are relatively low and where nesting success seemed poor. Could the Illinois populations of this species sustain themselves over the long run if all the bottomland habitat were destroyed? We do not know the answer, but the question is one that needs to be asked (and researched) about all species and all habitats. Ecological breadth in a population seems all to the good and may be essential. Because of the vagaries of weather and the unknown actions of other populations, the habitat that sustains a species in one year may not carry it at all in another. It is *not* enough just to know that a population occupies a particular habitat. Beyond that it is essential to know what that habitat contributes to the population and its survival *from year to year*. Such knowledge will come only from very *detailed, long-term* ecological investigations of every habitat and the populations that each supports. The importance of long-term studies is indicated in the dramatic change that occurred in the winter populations of kinglets between 1977 and 1978. How different our impression of the population of these species would be if we had only the 1978 data.

In the preparation of this paper we have benefitted particularly from contributions of data from Marilyn Campbell and her associates on the staff of the Vermilion County Conservation District and their many cooperators; H. David Bohlen of the Illinois State Museum; Vernon Kleen of the Illinois Department of Conservation; Mrs. William Carroll of Woodstock; and Bowie Hannah of Dix.

Though we do not usually mention it, the consistently fine help provided virtually every day in one way or another by staff at every level of the Illinois Natural History Survey is deeply appreciated and, more to the point, essential.

BLUE-GRAY GNATCATCHER
(Polioptila caerulea)

(Cover, Fig. 1 and 2)

Spring Migration

The blue-gray gnatcatcher usually arrives in southern Illinois in late March or early April. This arrival is surprisingly early for a small, insectivorous bird, and is before the last frosts in the area. The

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

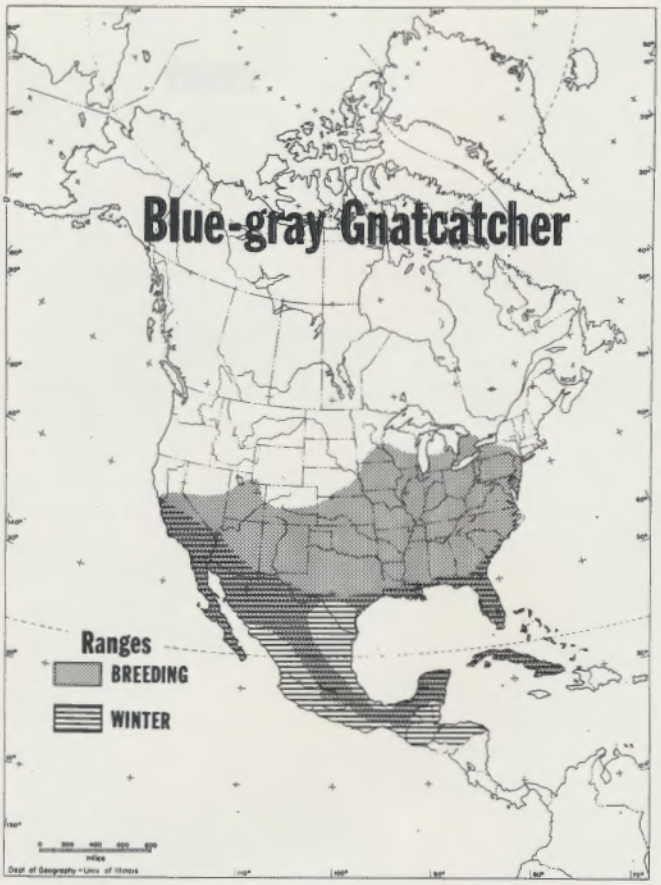

Fig. 2.—General distribution of the blue-gray gnatcatcher.

earliest arrival reported for southern Illinois is 15 March (Kleen unpublished 1977). The bulk of the migrants in southern Illinois are seen from mid-April to early May (Fig. 3). In central Illinois the earliest arrival thus far reported is 30 March (Smith 1930), and the bulk of the migration occurs from about 28 April to 12 May.

A published record for the gnatcatcher on 7 March in the Chicago area (Fawks 1965) is amazing if correct. More realistic as an early arrival date for northern Illinois is 2 April at Rockford (L. G. Johnson unpublished 1959), and gnatcatchers are not usually seen in the north much before mid-April, with largest numbers occurring in May.

The presence of breeding birds makes it difficult to determine precisely the end of the spring migration. William Dreuth found the gnatcatcher no later than 26 May in Lincoln Park, where the species was not known to nest (Clark & Nice 1950).

Distribution

The general distribution of the blue-gray gnatcatcher is shown in Fig. 2. In Illinois gnatcatchers are to be expected in every county, but definite nesting records are still lacking for many (Fig. 4). In addition to the localities shown, there are recent breeding records for Pike County and the Chicago area (Kleen unpublished 1977).

Nesting Habitats and Populations

Brief descriptions of gnatcatcher habitat appear in the Illinois literature. Nelson (1876–1877) and Woodruff (1907) speculated that the lack of "heavy timber" accounted for the scarcity of gnatcatchers in the Chicago area. Greer (1923) said that gnatcatchers invariably chose to nest in willows near water in the Aledo area, and Gates (1911) listed the species as a dominant in bottomland woods near Havana. Hess (1910) wrote that in the Philo area gnatcatchers were absent from the upland but occurred in low, wet woods along the Salt Fork. Near Berlin, Robertson (1944) found that gnatcatchers were largely confined to climax woods. In southern Illinois, Nelson (1877) found gnatcatchers common in the tall oaks of the bottomland near Mt. Carmel. Ridgway (1889) considered the habitat to be high, open woods, often along streams. A strikingly different habitat was scrub oak near Beach, where Sanborn (1922) found a family of gnatcatchers.

The primary breeding habitat for the blue-gray gnatcatcher in Illinois is riparian woods, where this bird usually occupies the first level above the floodplain. June populations of the gnatcatcher in all bottomland woods that we censused in southern Illinois, 1973–1978, averaged 18.6 birds per 40.5 ha, whereas those in upland woods averaged 7.6 birds per 40.5 ha (Table 1). Even in upland areas, the gnatcatcher is most often found along waterways. That bottomland woods is primary gnatcatcher habitat is also shown during population declines, when the decrease is most evident in upland (less preferred) habitat. For example, our breeding bird census for 1978 (a year in which bird populations were generally low) show that the population of gnatcatchers in bottomland forests in southern Illinois remained nearly the same as for the previous years (1973–1977), whereas the population in upland forests dropped to half the average for that period (Table 1). Gnatcatcher populations are generally more variable in upland than in bottomland habitat (Table 2).

Gnatcatchers have been recorded during the breeding season in southern Illinois towns (Ridgway 1887), but densities in residential habitat are very low (Table 1).

No characteristic of the vegetation (species composition, stem density, basal area) that we measured in our forest study areas in southern Illinois showed correlation with gnatcatcher populations.

Gnatcatcher populations in central and northern Illinois are now generally low, but available counts indicate that they were higher early in this century (Gault 1922, Clark & Nice 1950, Fig. 3). Gates (1911)

considered the gnatcatcher to be a dominant of bottomland woods along the Illinois River, where Frank Bellrose (unpublished) has found them uncommon since 1938. The spring bird count (Kleen 1973, 1974, 1975*a*, 1976, 1977) indicates that the gnatcatcher population in early May (which includes both transient

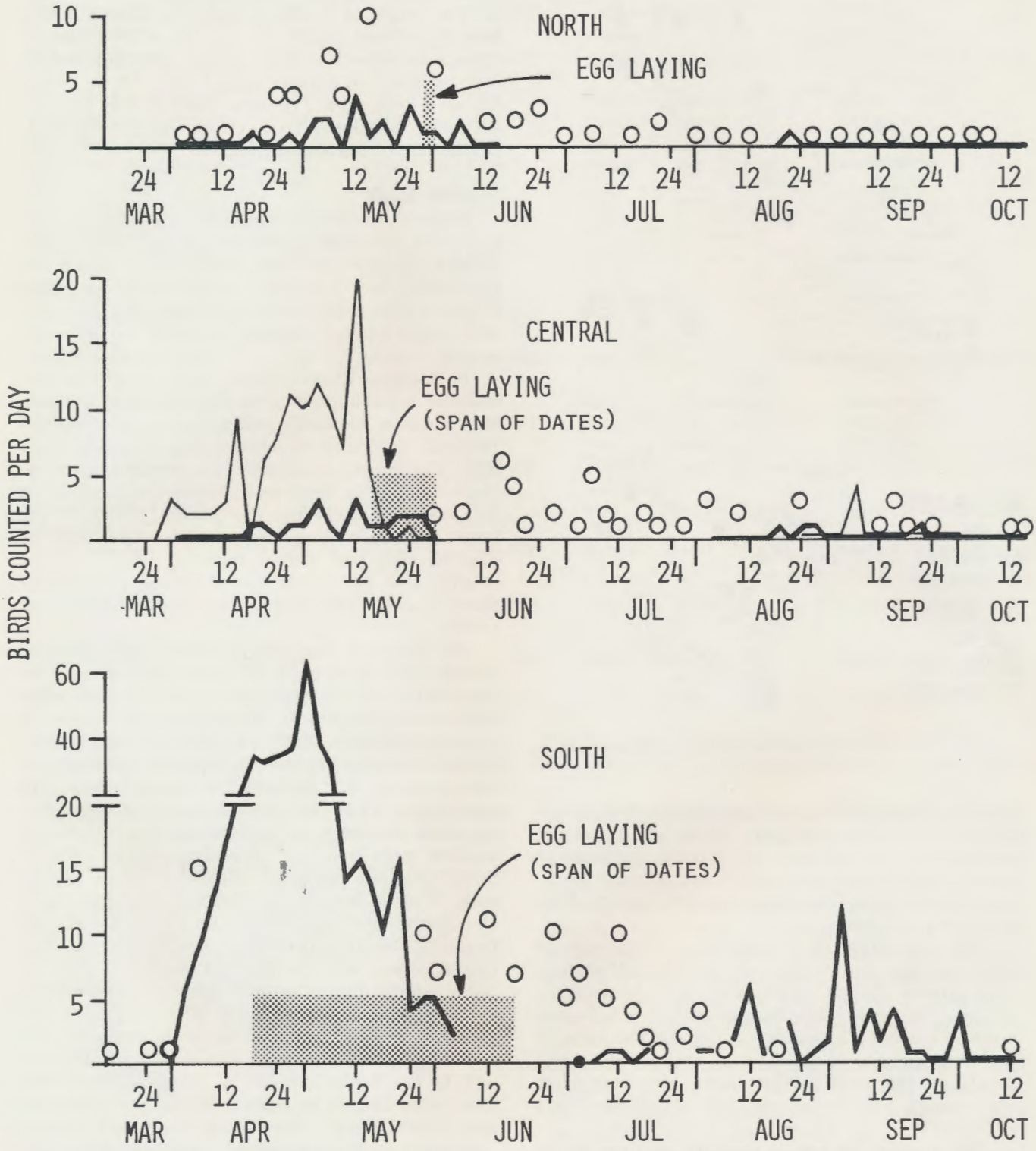

Fig. 3.—Egg-laying and migration seasons of the blue-gray gnatcatcher in different regions of Illinois (see Fig. 10 for regions). Spring and fall graph lines (heavy lines) show the highest daily count of each 4 days (1967–1970). Lighter line (central region) shows the highest daily counts of each 4 days made by F. Smith and his students, 1903–1925. 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.

BLUE-GRAY GNATCATCHER

BREEDING RECORDS

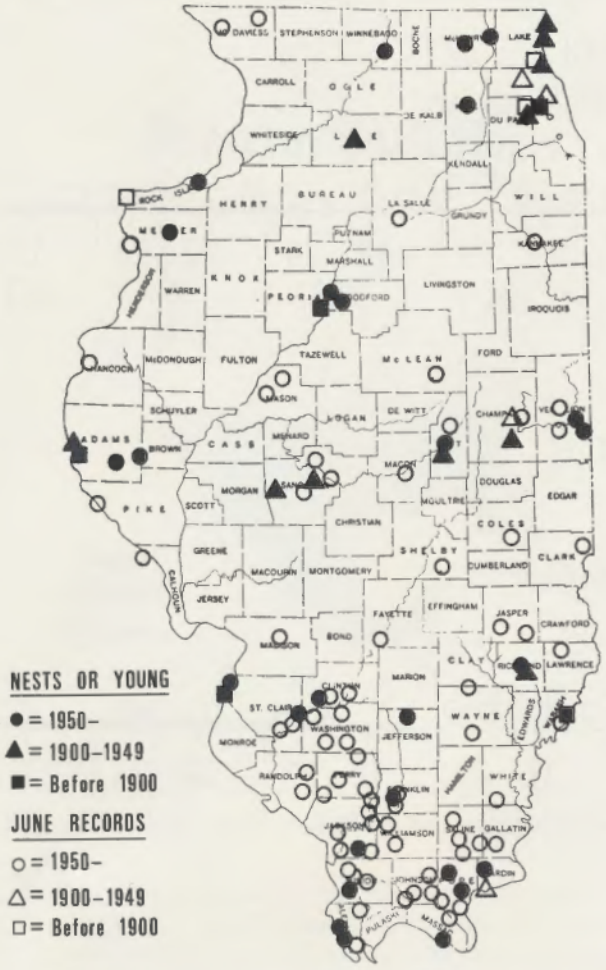

Fig. 4.—Breeding records of the blue-gray gnatcatcher in Illinois.

and breeding birds) is low in northern and central Illinois (0–0.4 bird per party hour). At about the latitude of Coles County, the number increases to about 1 gnatcatcher per party hour, and in the extreme south (Pope County) counts have been as high as 5 per party hour.

The population density of gnatcatchers may be influenced by the number of cowbirds *(Molothrus ater)* present. In our forest study areas in southern Illinois, the density of the gnatcatcher populations remained under 15 per 40.5 ha when the ratio of cowbirds to gnatcatchers was 1:1. In one bottomland woods, no gnatcatchers were found in a year when the cowbird population was high (33 cowbirds per 40.5 ha).

The gnatcatcher spends much of its time in the middle and upper canopy. J. Graber observed a gnatcatcher bathing on the dew on oak leaves about 30 feet above the ground. Trees chosen for nest sites (Table 3) reflect the habitat to some extent, but our list is biased in that most of the records represent a single tract of upland forest in Pope County. Greer (1923) said that near Aledo willows were invariably chosen as nest trees, often near water.

The height of 5 nests in northern Illinois ranged from 6 to 9 m (mean: 7.9 m); 13 nests in central Illinois were 6–15 m high (mean: 10.4 m); and 59 nests in southern Illinois ranged from 1.5 to 19.8 m (mean: 8.0 m), with a definite mode at 6–10 m. The nest may be placed in a crotch, as in Fig 1, or saddled on a horizontal limb.

Nesting Cycle

Ridgway (1889) described the gnatcatcher's song as a weak imitation of the song of the catbird *(Dumetella carolinensis),* with considerable power but little sweetness. The high pitched song also seems to lack a consistent or distinctive pattern. The common call, a wheezy, squeaky "Zeee-eef" carries a surprising distance.

In northern Illinois, Greer (1923) found that nest building began about a week after arrival of the pair. Nest building begins in southern Illinois at least by 14 April. J. Graber watched a pair choosing a nest site. The female examined four crotches in a red elm by sitting in them and turning her head about and shaping herself into the crotch. The male followed the female about, singing softly. The following day the pair had started building in one of the crotches that the female had examined. Nest building in southern Illinois has been described by Hunter (1969).

We observed that nest materials were gathered within about 1–30 m of the nest sites, but once we saw a pair going 90 m, apparently outside their usual territorial limits and at the edge of the habitat, to gather spider web. Both members of a pair usually work at building the nest, but in one instance a female built the nest by herself in about 3 days. The male followed her about and chased away a neighboring male whenever it approached her. Twice we watched pairs building for a short period (40 minutes). One pair made 27 trips (the female 20, the male 7) with nesting material; another pair made 19 trips in that time (the male 11, the female 8). The female of the latter pair spent considerable time putting materials into the nest and shaping it with her body. Several times her mate (Fig. 5) gave her material he had gathered. Each bird sat in the nest (separately) and extended its head over the side, attaching spider web over the outside of the nest and to the limbs holding it. Gnatcatchers chased away other species of birds (catbird; yellow-breasted chat, *Icteria virens;* and female cardinal, *Cardinalis cardinalis)* which approached their nest while they were building.

The nest (cover, Fig. 1 and 6) is a deep cup made of various soft plant materials held together and at-

TABLE 1.—Breeding populations of blue-gray gnatcatchers in various Illinois habitats.

Habitat	Hectares	Birds per 40.5 ha[a]	Years	Type of Census	Region or County	Reference
Urban residential	139	0.3	1976–1977	Strip	South	This paper
Oak-maple forest	22	3.6	1928	Map	Champaign (C)[b]	Kendeigh 1944
Oak-maple forest	22	0.0	1924–1977 (except 1928)	Map	Champaign (C)	Kendeigh 1948*b*, Kendeigh & Edgington 1977
Oak-hickory-maple forest	13	6.3	1976	Map	McLean (C)	Birkenholz 1977
Oak-hickory-ash forest	16	6.0	1966–1971	Map	Vermilion (C)	Willson 1974
Bottomland (floodplain) forest	1.7	26.0	1966	Map	Vermilion (C)	Karr 1968
Bottomland (floodplain) forest	10	16.0	1966–1971	Map	Piatt (C)	Willson 1974
Bottomland woods	94	0.2	1978	Strip	Central	This paper
Grazed bottomland woods	21	3.8	1955	Map	Macon (C)	Chaniot & Kirby 1955*b*
Virgin floodplain forest	31	2.7	1948	Map	Sangamon (C)	Snyder et al. 1948
Mature bottomland forest	957	0–59 (avg 18.6)	1973–1978	Strip	South	This paper
Swamp and thicket	5	15.4	1950	Map	Jackson (S)	Brewer & Hardy 1950
Upland deciduous forest	8	0–10 (avg 3.3)	1914–1916	Nest	Rock Island (N)	J. J. Schafer unpublished
Upland deciduous forest	22	0–5 (avg 1.1)	1917–1923	Nest	Rock Island (N)	J. J. Schafer unpublished
Upland oak-hickory forest	23	3.6	1944	Map	Sangamon (C)	Robertson 1944
Upland forest	13	6.0	1966–1971	Map	Piatt (C)	Willson 1974
Upland forest	43	0.0	1978	Strip	Central	This paper
Mature upland forest	511	2–27 (avg 7.6)	1974–1978	Strip	South	This paper
Upland deciduous forest	6	39.5	1976	Map	Jackson (S)	Morrison & Peterjohn 1977
Forest (all types, including edge)	72	0–4 (avg 2.1)	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	87	1–3 (avg 2.3)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	138	6–12 (avg 8.9)	1957–1958	Strip	South	Graber & Graber 1963
Shrub	52	0–3 (avg 1.5)	1957–1958	Strip	South	Graber & Graber 1963

[a] All figures were converted to birds per 40.5 ha (number of territorial males or nests × 2).
[b] N refers to the northern region of Illinois, C to the central, and S to the southern region, as shown on winter distribution maps, e.g., Fig. 10.

TABLE 2.—Annual variation in breeding gnatcatcher populations in bottomland and upland forests in southern Illinois.

Year	Gnatcatchers per 40.5 ha	
	Bottomland Forest	Upland Forest
1974	15.5	6.1
1975	13.4	14.0
1976	19.6	4.9
1977	22.5	8.9
1978	17.8	3.7
Mean	*17.8*	*7.5*
Standard deviation	*3.5*	*4.1*
Coefficient of variation	*0.199*	*0.544*

tached to the substrate with spider web. Inside it is often lined with hair. The hair lining of a nest in Pope County appeared to be from an oppossum, *Didelphis virginiana*. Materials used in the feltlike walls of nests included small pieces of cedar, river birch, and other bark; fine grass stems; small rootlets; cottony fibers from milkweed; skeletonized leaves; and the hair found around the bases of sycamore seeds (nutlets). A consistent feature of the nest is its outside covering of gray and glaucous lichens, which tends to camouflage the nest, making it look like a knot on a limb (Ridgway 1889). One of the lichens has been identified as *Parmelia caperata* by J. L. Crane of the Illinois Natural History Survey. Measurements of two nests from Pope County were: inside diameter at the rim, 3–3.5 cm; inside depth, 4 cm; and wall thickness, 0.25–1.0 cm.

Nest building observed at 25 nests in Pope County required 3–5 days with very little time (not more than a day) between the comupletion of the nest and the laying of the first egg. The gnatcatcher is par-

TABLE 3.—Nest sites of the blue-gray gnatcatcher in different regions of Illinois.

Tree Species	Number of Nests		
	North	Central	South
Elms, *Ulmus* sp.		1	2
Winged elm, *U. alata*			12
Slippery elm, *U. rubra*			1
American elm, *U. americana*			1
Oaks, *Quercus* sp.			2
White oak, *Q. alba*		1	10
Red oak, *Q. rubra*		1	1
Spanish oak, *Q. falcata*			1
Cherrybark oak, *Q. falcata pagodaefolia*			1
Chinquapin oak, *Q. muhlenbergii*			1
Shingle oak, *Q. imbricaria*			1
"Swamp oak"			1
Sugar maple, *Acer saccharum*			5
Scyamore, *Platanus occidentalis*		2	3
Black walnut, *Juglans nigra*		5	
River birch, *Betula nigra*			4
Sassafras, *Sassafras albidum*			3
Honey locust, *Gleditsia triacanthos*			3
Ash, *Fraxinus* sp.			2
Willow, *Salix* sp.	1	1	
"Shellbark hickory"		1	
Persimmon, *Diospyros virginiana*			1
Ironwood, *Ostrya virginiana*			1
Wild black cherry, *Prunus serotina*			1
Sour gum, *Nyssa sylvatica*			1
Hackberry, *Celtis occidentalis*			1
Loblolly pine, *Pinus taeda*			1

asitized by the cowbird (Fig. 6), sometimes heavily (Friedmann 1963), and often abandons its nest, seemingly as a result of cowbird activity. Little time elapsed between the abandonment of a nest and the building of another. In most cases we saw the pairs removing nest material from the earlier nest, using it to rebuild before we were aware that they had given up the former attempt. At least four pairs each built three different nests in one season (1973). A large part of the gnatcatchers' energy budget is spent on nest building.

It may be that the most efficient way to build quickly in another site is to reuse the material from the abandoned nest. Bent (1949) has suggested that the gnatcatcher reuses its nesting materials because of the brief seasonal occurrence of the materials, e.g., oak catkins. A scarcity of desirable nesting material is suggested by the observation of Comfort (1954), who saw a yellow-throated warbler *(Dendroica dominica)* pilfering nest material from a gnatcatcher's nest in the St. Louis area. Subsequent nests are often fairly close to the previous nest site. Mrs. William Carroll of Woodstock observed a pair rebuilding only 15 m from the earlier nest.

The eggs of the gnatcatcher are pale bluish white, with irregular spots of reddish brown (Fig. 6). The egg-laying season extends from at least 18 April to 18 June in southern Illinois (Fig. 3). We have data on clutch size from only 12 nests for Illinois: 2 eggs, one set; 3 eggs, one; 4 eggs, seven; and 5 eggs, three sets. It is not known whether the gnatcatcher is double brooded in Illinois.

Both adults incubate the eggs. In 90 minutes' observation, J. Graber saw the female of one pair

Fig. 5.—Blue-gray gnatcatcher carrying building material for its nest, 5 May 1973 in Pope County. Note the bird's white outer tail feathers.

Fig. 6.—Nest with eggs of the blue-gray gnatcatcher and one cowbird egg. Photographed 11 May 1973 in Pope County.

spend 10 minutes setting, leave, return shortly, and spend 8 more minutes on the nest before she was relieved by the male. He spent 10 minutes on the nest before the female returned and sat for 20 minutes. The male then sat for 30 minutes before the female came back. She was on the nest when observation ceased. A female gnatcatcher was observed feigning injury for a distance of 90 m when flushed from eggs that she had been incubating for 4–5 days.

The incubation period is around 13 days, and the young spend at least 11 days in the nest with both parents caring for them. How long after fledging the young are cared for by the adults is unknown, but young nearly as large as the adults have been observed being fed by the adults. The total length of the nest cycle from the beginning of the nest to fledging is 33–38 days. Renesting attempts ceased in early July in 1973 in southern Illinois.

Gnatcatcher territory size is small. For 25 pairs of gnatcatchers observed in 1973 in an area of about 36 ha of habitat (upland wooded ravines and a small stream) the territory size appeared to be about 0.37 ha.

Our observations of a gnatcatcher population in upland habitat in Pope County in 1973 showed nesting success to be very poor. Of 31 nests built by 20 pairs, only 4 fledged gnatcatchers, and 1 nest fledged a cowbird but no gnatcatchers. More data are needed on the productivity of gnatcatchers in both upland and bottomland habitats. Because of their size and locations, it is difficult to see the contents of most gnatcatcher nests, and thus, difficult to obtain precise histories. Causes of nest failures included at least the following—cowbird activity, predation, and weather. Wind was noted as the cause of destruction of gnatcatcher nests in northern and central Illinois (Loucks unpublished 1890; Mrs. W. Carroll unpublished 1964; M. F. Campbell unpublished 1974).

In mid- and late summer, gnatcatchers become very quiet and inconspicuous. Some are still caring for fledged young in late July. Sanborn (1921) saw adults with full-sized young at Beach on 24 July, and Nelson (1877) reported "half-fledged" young at Mt. Carmel at the last of July.

The post-nuptial molt may be early, as we saw a male which appeared to be in fresh plumage on 28 July 1973 in Pope County.

Fall Migration

The onset of the fall migration of gnatcatchers is difficult to determine. As in most species with small populations to the north of Illinois, the fall migration of the blue-gray gnatcatcher is relatively inconspicuous here (Fig. 3). The last dates when gnatcatchers have been reported by observers in various northern Illinois localities range from 22 July at Port Byron (Schafer 1917–1918) to 7 October at Rockford (Van Duzer 1920). In central Illinois last dates on which gnatcatchers have been seen range from 27 July at Allerton Park (Bursewicz 1961) to 15 October at Rantoul (Bent 1949) and 16 October at Monmouth (Kleen 1978). Records of departure from the southern Illinois region range from 10 September (George 1968) to 12 October (Jones 1935). The highest fall counts of gnatcatchers have occurred between 1 and 6 September in southern and central Illinois (Fig. 3). The ratio of our spring-to-fall counts was about 11 gnatcatchers in spring (April–May) to 1 in fall (August–September), perhaps reflecting the inconspicuousness of the species in the fall.

The migration of gnatcatchers has apparently never been seen directly, and its characteristics are unknown, fall or spring. No specimens of gnatcatchers have been recovered from television tower kills in Illinois, but species with low populations north of Illinois are rarely killed on Illinois towers, and none are to be expected.

Food

There are no published accounts on the food of the blue-gray gnatcatcher in Illinois, and data are much needed.

Specimen Data

Ridgway (1904) said that the nominate race *(P. c. caerulea)* was the breeding form in Illinois and gave these average measurements from a series that included Illinois specimens: wing, 52.8 mm (male) and 50.5 (female); tail, 50.7 mm (male and female); tarsus, 17.1 mm (male) and 17.2 (female); exposed culmen, 9.8 (male) and 10.0 (female).

GOLDEN-CROWNED KINGLET
(Regulus satrapa)

(Fig. 7 and 8)

Spring Migration

Because golden-crowned kinglets winter in Illinois, the exact beginning of the spring migration may be obscured by the presence of the winter population. This is particularly true in southern Illinois, where the difference between winter population densities and spring densities appears to be subtle (Fig. 9). The migration of kinglets has never been seen directly, but is presumed to be nocturnal (see Fall Migration).

In central Illinois, Musselman (1931) noted a definite increase in golden-crowns on 16 February, but most observers do not detect influxes until the latter half of March (Anonymous 1916, 1917; Craigmile 1918; Gault 1901*a*). In central and northern Illinois, spring counts of golden-crowns show a definite peak between 20 March and 12 April (Fig. 9).

Fig. 7.—Golden-crowned kinglet. The crown is yellow in the female, bright orange and yellow in the male.

Especially notable influxes of golden-crowns have been reported at the end of March (Fawks 1967; Musselman 1934–1935), but counts of as many as 100 golden-crowns per day are exceptional. Most of the population has passed through Illinois by the end of April. We have never detected golden-crowned kinglets in Illinois in May, but there are some reliable records for that month, as late as the 6th in southern Illinois (Cooke 1915), the 18th in central Illinois (Fawks 1972), and the 27th in northern Illinois (Clark & Nice 1950; Kleen 1975*b*). A reference to golden-crowns having remained all summer near Polo (Cooke 1888) is of uncertain validity.

Our spring counts of golden-crowns were extremely variable (Fig. 9), but such variation may not be unusual for the species (Nolan 1955). Because of their small size, kinglets are subject to winterkill, a phenomenon that would cause spring counts to be low in some years (Nolan 1956*a*, and see Winter Populations). The apparent regional variation in our counts, we suspect, is actually annual variation from causes unknown. During the migration seasons golden-crowned kinglets probably occur in every township in the state.

Kinglets are primarily arboreal species, and though they also forage on herbaceous plants, they are not likely to be found far from woody hatitat—at least shrubs. They are often found in association with conifers (Swink 1965).

We have rarely heard golden-crowned kinglets sing in Illinois. Peattie (1938) characterized the song as lovely—rising in a sweet twitter—and he, as well as Farwell (1919) and Gault (unpublished) heard the song in northeastern Illinois. In contrast to the song, the call—a very high-pitched, often three-noted "tree-tree-tree"—is uttered frequently at all seasons (Baldwin 1941).

Fall Migration

Though golden-crowned kinglets nest at least as close as northern Wisconsin (Fig. 8), they do not begin to reappear in Illinois until September. The earliest fall records are 12–14 September in northern Illinois (Roberts 1921; Ford 1932; Blake & Smith 1941; Clark & Nice 1950), 21 September in central

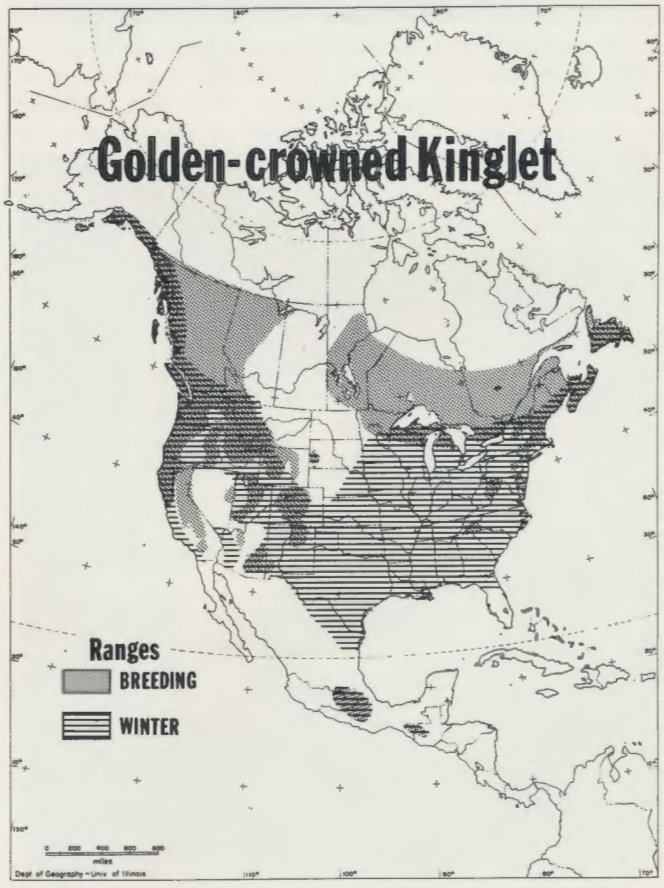

Fig. 8.—General distribution of the golden-crowned kinglet.

Illinois, and 26 September in southern Illinois (Jones 1940). The population of transient golden-crowns remains relatively high through October in central and northern Illinois and then usually drops off in November (Fig. 9), but Patterson (1920) and Musselman (1930) reported golden-crowns to be numerous in late November and early December, suggesting late migration waves. In northeastern Illinois during 8

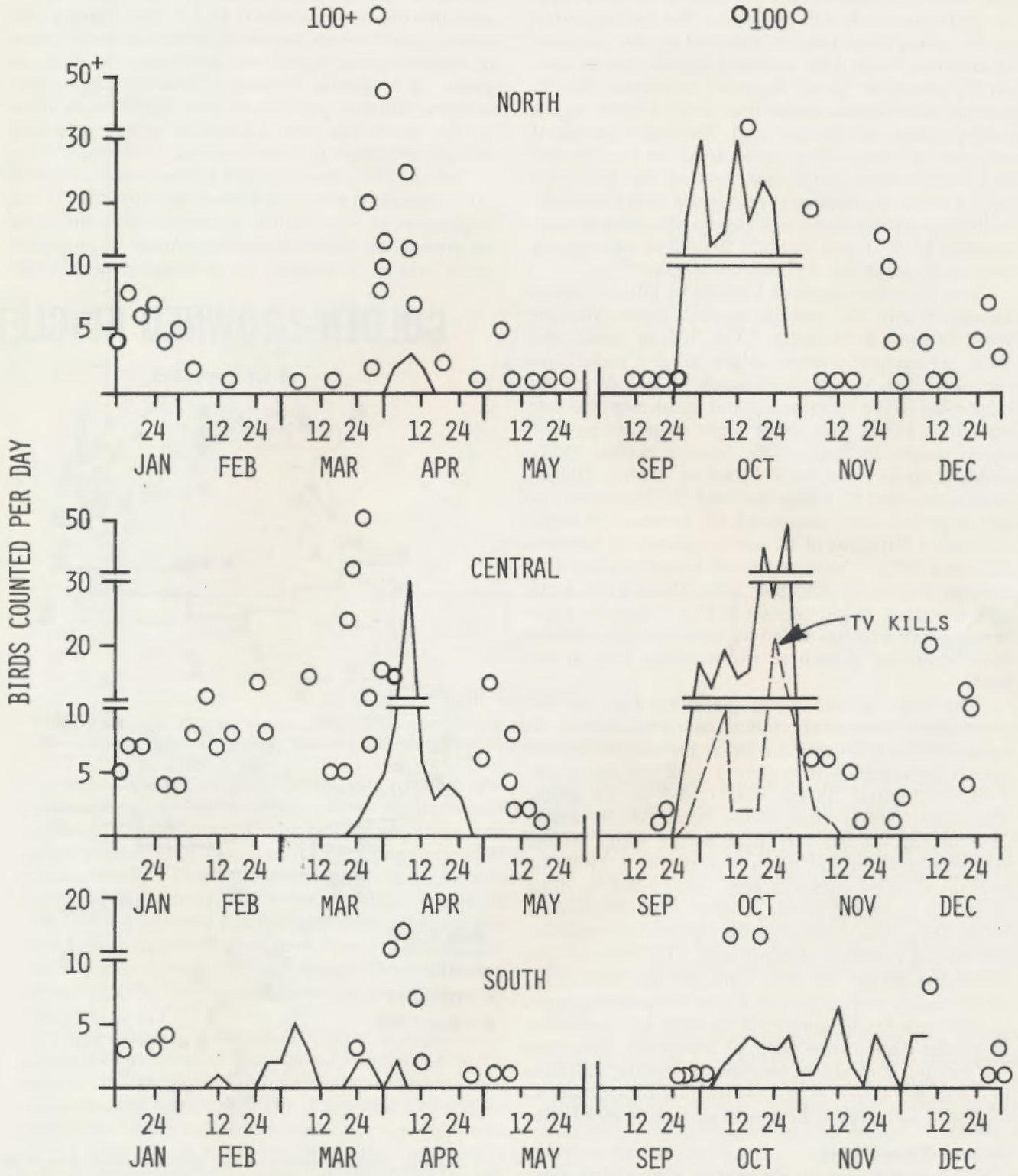

Fig 9.—Migration seasons of the golden-crowned kinglet in different regions of Illinois. Spring and fall graph lines show the highest daily count of each 4 days (1967–1970). Hollow circles represent counts made in other years or by other observers.

years of observation, Gault (1901*b*) noted the latest golden-crown on 11 December. In the St. Louis area Widmann (1907) stated that the bulk of the transient golden-crowns passed on 10–20 October and that the last moved through during the first week of November. The end of the fall migration, like the beginning of the spring migration, is obscured by the presence of wintering birds. Our southern Illinois counts show little evidence of "peak" flights of transients (Fig. 9), but the same census route that yielded three to six golden-crowns in October and November produced only one or, more often, none at all in late December; so we would judge that most of the transients have passed the southern region by mid-December. Anderson's (1964) statement that golden-crowns were common at St. Louis in early December but uncommon later points to the same conclusion.

The migration waves of kinglets in fall are clearly associated with the passage of cold fronts (Bennett 1952; Wasson & Shawvan 1953; Nolan 1956*b* and 1958). Overnight changes in the kinglet population (Bennett 1952; Wasson & Shawvan 1953) indicate the migration to be nocturnal, and golden-crowns are sometimes killed with other night migrants on television towers (Petersen 1959; Seets & Bohlen 1977). Golden-crowns have been killed at central Illinois towers between 27 September and 12 November, in which period they constituted 0.8 percent (39 birds) of about 4,700 birds of all species picked up between 1955 and 1972. They constituted a much higher percentage (3.6) of the October kills (about 1,000 birds of all species). It can be seen in Fig. 9 that the numbers of golden-crowns killed on central Illinois towers show a similar pattern to the numbers seen in the field.

The ratio of our spring (February–May) to fall (September–November) counts was very low—1 in spring to 7 in fall—for the state as a whole, but varied greatly from region to region—1 to 25 in the north, 1 to 5 in central Illinois, and 1 to 3 in the south. The extraordinary ratio in the north can be attributed in part to the very poor spring count in the year (1968) when the north was censused. William Dreuth recorded golden-crowns about twice as often in fall as in spring (Clark & Nice 1950; Eiseman & Shank 1962), but this was only a measure of frequency and not of numbers of birds seen. To interpret the spring:fall ratios, we need data on age ratios (i.e., productivity) and migration routes of golden-crowns. In our very small sample (6) of aged fall specimens of golden-crowns, the ratio of adults to immatures was 1.0 to 2.5, or the equivalent of a spring:fall ratio of 1.0 to 3.5, which is at least roughly comparable to the ratios we recorded in central and southern Illinois.

Winter Populations

As with most species, the specific factors that affect the population size and distribution of kinglets are unknown. Golden-crowns probably occur in every Illinois county during the winter, though records are still lacking for many (Fig. 10), reflecting lack of coverage. The number of golden-crowns recorded on Christmas counts fluctuates greatly from year to year, with no consistent pattern (Fig. 11). Surprisingly, the counts also show no consistent difference from region to region and no significant correlation between regions. More precise censuses (Table 4) suggest that southern Illinois populations are higher than those to the north, and the Christmas counts may lack enough precision to show regional differences.

Swink (1965) observed that golden-crowns are most often associated with evergreens, and that also is our impression of the habitat preference, but there are no population figures for golden-crowns in any coniferous habitat in Illinois. No measurable populations

Fig. 10.—Winter records of the golden-crowned kinglet in Illinois. Heavy horizontal lines separate the three regions (north, central, and south) referred to in the text.

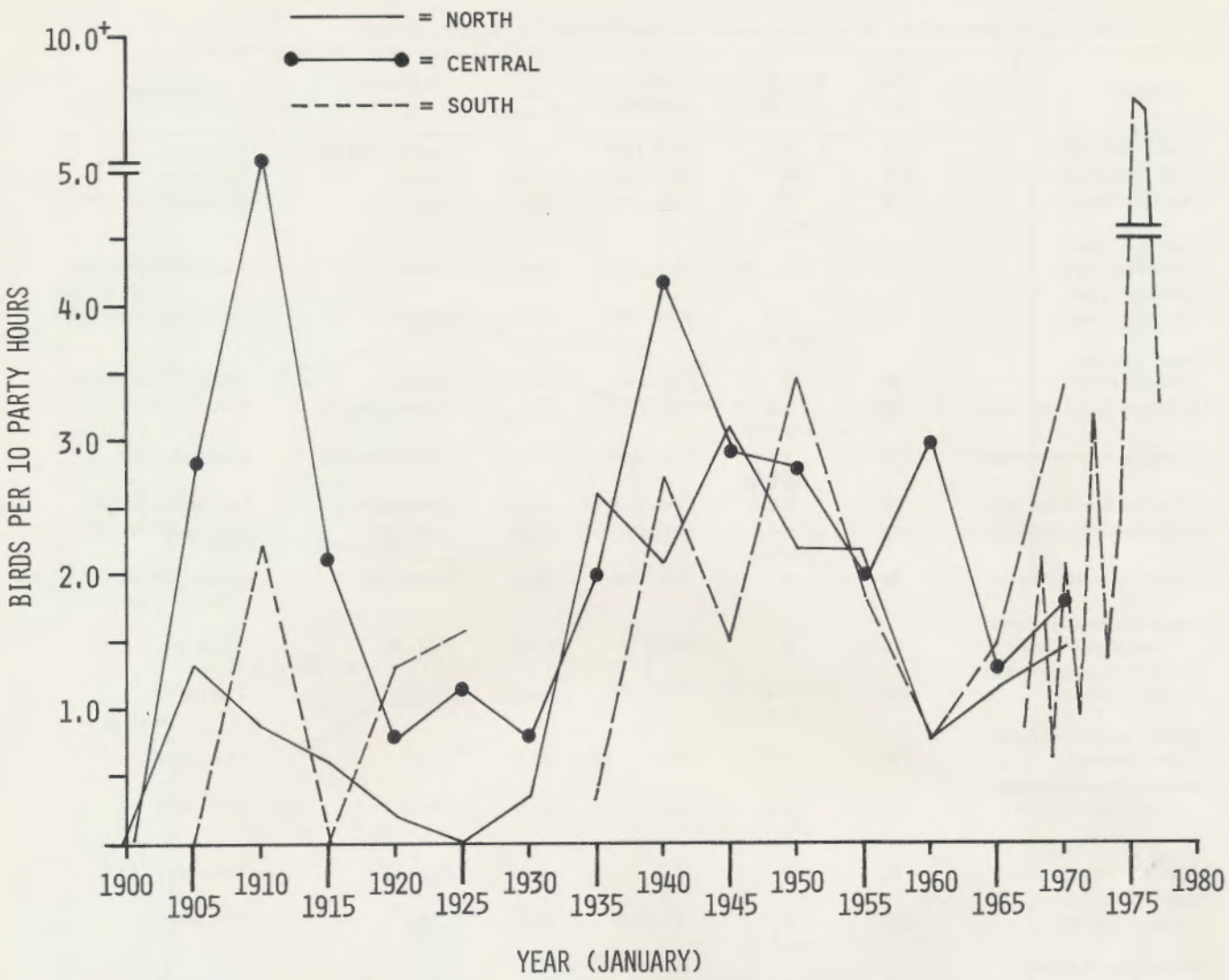

Fig. 11.—Golden-crowned kinglets seen per 10 party hours on Audubon Christmas counts in the three regions of Illinois. Each point represents a 5-year average. Annual variation in the counts for the last 10 years is shown for the southern region.

have been reported in other than woody habitats, and based on population densities, forest (of deciduous habitats) is preferred (Table 4). Shrub areas and urban habitat both have much lower populations of golden-crowns. Our censuses of southern Illinois forests (Graber et al. 1977) show a high degree of correlation ($r = 0.944$, $P = 0.01$) between golden-crown populations in bottomland and those in upland forests in various years, but our counts show no correlation with the Christmas counts in the same years (Fig. 12).

There was no significant difference in densities of golden-crowns between bottomland and upland forest habitat, and we could find no character (basal area, stem densities, Importance (Y) of any genus of tree or shrub) that correlated with golden-crown populations.

For their size, kinglets are remarkably cold hardy, but the extremely cold winter of 1976–1977 caused catastrophic population losses among golden-crowned and ruby-crowned kinglets (Graber & Graber 1979). Golden-crowns were present in normal numbers in our southern Illinois forest study areas in early January 1977, but by mid-February they had disappeared, and the population showed little recovery by the following year (Fig. 12 and Table 4). A similar kill probably occurred in January 1956 (Nolan 1956*a*), which accounts for the near absence of kinglets in Illinois in 1957 and 1958 (Tables 4 and 5).

Food

Both golden-crowned and ruby-crowned kinglets forage from the tops of the trees to near the ground, but we have never seen a live one on the ground. They move quickly and almost continuously, looking over branches, leaves, buds, and flowers of woody as well as herbaceous plants. They often flutter at the tip of a branch, picking up food as they hover. They appear to take their food from the surface of the

TABLE 4.—Winter populations of golden-crowned kinglets in various Illinois habitats.

Habitat	Hectares	Birds per 40.5 ha	Years (January)	Type of Census	Region or County	Reference
Urban residential	173	0	1976, 1978	Strip	North & Central	This paper
Urban residential	273	0	1976–1978	Strip	South	This paper
Suburban woodlot	8	0–5 (avg 1)	1968–1972	Map	Lake (N) [a]	Miller & Miller 1972
Forest (all types, including edge)	18	0	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	62	0–1 (avg 0.6)	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	85	0	1957–1958	Strip	South	Graber & Graber 1963
Oak-maple forest and edge	23	0–4 (avg 0.5)	1925–1943	Map	Champaign (C)	Kendeigh 1944
Oak-maple forest and edge	23	0–4 (avg 1.1)	1944–1948	Map	Champaign (C)	Kendeigh 1948*a*
Oak-maple forest and edge	23	0–2	1949–1976	Map	Champaign (C)	Kendeigh et al. 1953
Bottomland elm-maple forest	20	0–4 (avg 2.0)	1950–1953	Map	Cook (N)	Montague 1950, 1953
Grazed bottomland forest	21	2	1955, 1957	Map	Macon (C)	Chaniot & Kirby 1955*a*, Kirby & Chaniot 1957
Mature bottomland forest (1 year after blizzard)	60	0	1978	Strip	Piatt (C)	This paper
Mature bottomland forest (before blizzard)	644	0–10 (avg 5.5)	1974–1977	Strip	South	This paper
Mature bottomland forest (after blizzard)	186	0	1977	Strip	South	This paper
Mature bottomland forest (1 year after blizzard)	306	0–4 (avg 0.9)	1978	Strip	South	This paper
Mature upland forest (1 year after blizzard)	81	0	1978	Strip	Piatt (C)	This paper
Mature upland forest (before blizzard)	341	0–7 (avg 5.6)	1974–1977	Strip	South	This paper
Mature upland forest (after blizzard)	91	0	1977	Strip	South	This paper
Mature upland forest (1 year after blizzard)	176	0–2 (avg 0.2)	1978	Strip	South	This paper
Shrubby field and forest edge	34	0–(+) [b]	1955–1956	Map	Richland (S)	Shaw & Stine 1955, Shaw et al. 1956
Shrubby field	16	0–(+)	1958–1965	Map	Lawrence (S)	Shaw 1958, 1962
Shrubby field	16	2	1968	Map	Lawrence (S)	Hundley et al. 1968

[a] N refers to the northern region of Illinois, C to the central region, and S to the southern, as shown on winter distribution maps, e.g., Fig. 10.
[b] The plus symbol (+) indicates fewer than one bird per 40.5 ha.

plant, but the food is so small, and the birds so quick that we have never seen what it is that they eat. Forbes (1882) examined the stomachs of 18 golden-crowns (4 from spring, 12 from fall, and 2 from winter) and 30 ruby-crowned kinglets (26 spring, 2 fall, and 2 winter); so his spring data represent primarily ruby-crowns and the fall data, primarily golden-crowns. Forbes (1882) considered the habits of the two species of kinglets to be so similar that, in his discussion of their food, he lumped the data for the two. In spring, dipterans (gnats) were the most common food (33 percent of the total), with beetles (25 percent)—especially leaf-eating beetles *(Xanthonia decemnotata)* and scavenger beetles *(Aphodius inquinatus, A. femoralis)*—nearly as important. In fall, Lepidoptera (33+ percent)—especially winged moths—and Hemiptera and Homoptera combined (29 percent) were the most important food groups for kinglets. In winter, hemipterans (39 percent), mistletoe fruit (25 percent), spiders (17 percent), and cutworms (16 percent) were the dominant foods. The kinglets are apparently opportunistic, taking insects that are in ample supply and sometimes feeding exclusively on one species.

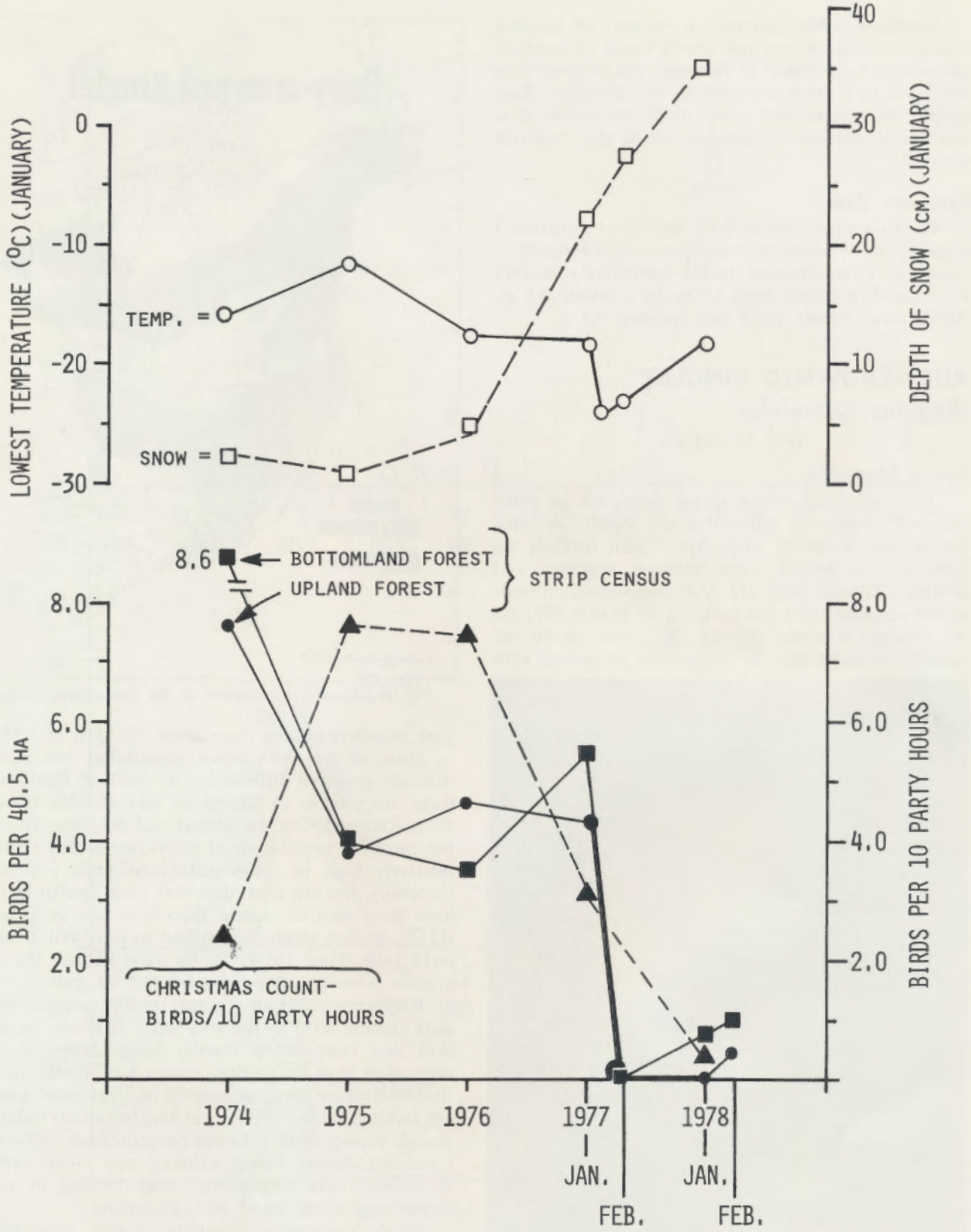

Fig. 12.—Comparison of Christmas counts with winter strip censuses of golden-crowned kinglets in bottomland and upland forests of southern Illinois, 1974–1978, inclusive. February data are shown for 1977 and 1978 only. The upper panel shows accompanying extremes of temperature and snow cover in the region. Note that the population crashed between January and February of 1977, coinciding with extreme cold, though the Christmas count did not show this decline until 1978.

Needham (1909) referred to "scores" of kinglets having been caught on the bristly heads of burdock plants near Lake Forest in October. He believed that the birds had been attracted to an abundant food supply, and mentioned particularly the larvae of a small moth *(Metzneria lapella)* and of the "burdock weevil."

Specimen Data

We have examined only 15 specimens (8 males, 7 females), all of which represent the eastern form *(R. s. satrapa)*. Three October males (moderately to very fat) ranged in weight from 5.7 to 7.4 g (mean: 6.6 g). An October female (very fat) weighed 6.1 g.

RUBY-CROWNED KINGLET
(Regulus calendula)

(Fig. 13 and 14)

Spring Migration

The beginning of the spring migration of ruby-crowned kinglets in Illinois is not usually detected before late March or early April, with little or no difference in arrival dates between southern and northern Illinois (Fig. 15). An exceptional number of ruby-crowns (100) was seen on 30 March 1967 on the Chicago lakefront (Fawks 1967), but we do not usually see more than 20–30 per day in spring, with peak numbers passing from about 12 April to 1 May.

Fig. 13.—Ruby-crowned kinglet photographed in Piatt County, May 1971. Females lack the red crown patch for which the species is named.

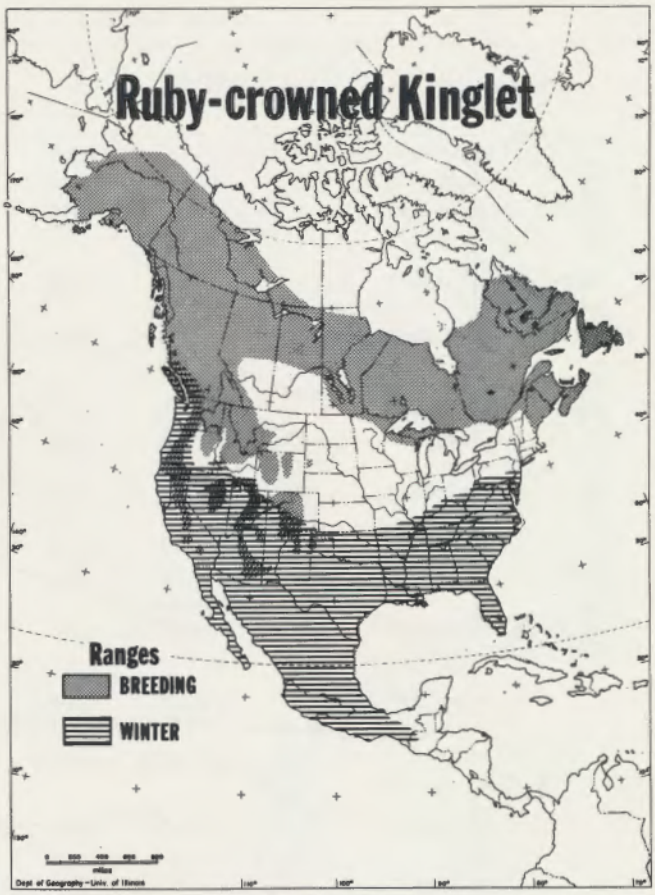

Fig. 14.—General distribution of the ruby-crowned kinglet.

Most of the ruby-crown population has passed through southern Illinois by the end of April, but there are records as late as 14 and 15 May (Cooke 1915, George 1968). In central and northern Illinois the transient population of ruby-crowns may remain relatively high in some years even until mid-May. Generally, few are seen after that time, but stragglers have been seen in central Illinois as late as 4 June (H. D. Bohlen unpublished) and in northern Illinois on 8 June (Ford 1956). So far as is known, the migration is nocturnal (see under Fall Migration).

Ruby-crowns are an arboreal species, foraging from near ground level to the tree tops. It is our impression that ruby-crowns usually forage lower in the vegetation than do golden-crowns, but specific quantitative data on foraging heights and preferred plants are lacking for both species of kinglets in all habitats and all seasons. Both Silloway (unpublished 1921–1924 typescript, Peoria Public Library) and Swink (1965) mentioned that ruby-crowns were feeding in hawthorns and other small trees in spring.

As do some other transient species, some ruby-crowned kinglets appear to set up "territories" during their passage through Illinois, especially in April. Males defend their areas against other males in a

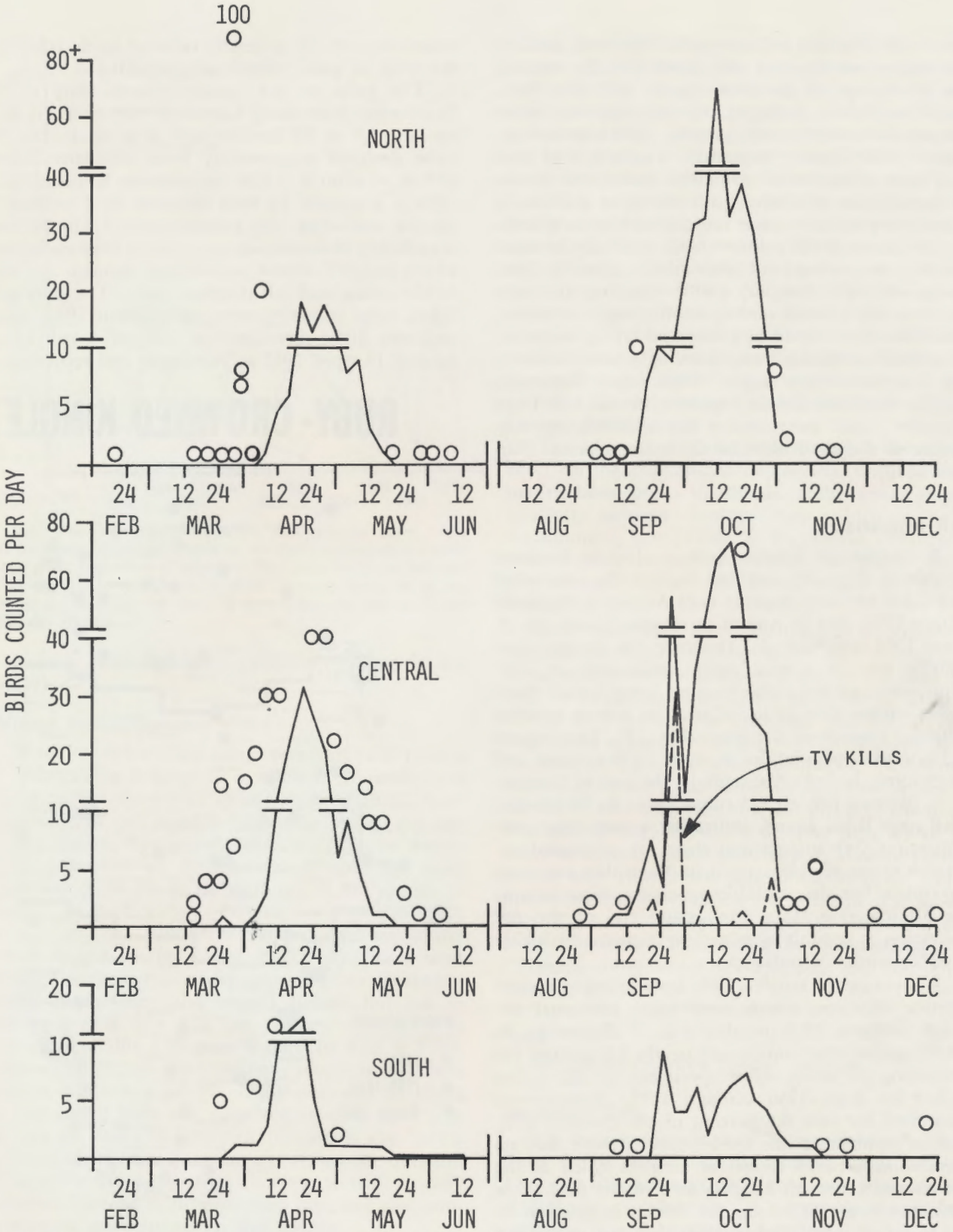

Fig. 15.—Migration seasons of the ruby-crowned kinglet in different regions of Illinois. Spring and fall graph lines show the highest daily counts of each 4 days (1967–1970). Hollow circles represent counts made in other years or by other observers. Dash line shows the number of ruby-crowned kinglets killed at television towers in central Illinois, 1955–1972.

ritualistic display. As two males face one another the red crown feathers are raised rapidly, making the whole top of the head appear red. The birds arch their necks, pointing the ruby crowns toward one another, and then fly in circles about one another, all the while singing frequently. The length of time that these "territories" are held cannot be known without studies of banded birds, but some individuals appear to stay in the same area for as long as a week.

In contrast to the golden-crown, male ruby-crowned kinglets are strong and persistent singers in both spring and fall. Ridgway (1889) described the song as a delicate, musical warble, astonishingly protracted and beautifully varied by rising and falling cadences. The song sometimes seems amazingly loud considering the size of the singer. Even more frequently, ruby-crowns utter a short explosive, double-noted call ("cha-ret") and sometimes a harsh chattering, suggestive of the scold notes of the house sparrow (Farwell 1919).

Fall Migration

Ruby-crowned kinglets nest as close as northern Wisconsin (Fig. 14), and the earliest the southward migration has been detected is 24 August in the north (Kleen 1978) and 28 August in central Illinois (A. O. Gross 1904 unpublished). However, the species is not usually seen in Illinois again until early or mid-September, marked influxes often being noted about 20 September with little variation in timing between different regions of the state (Fig. 15). Our counts indicate peak populations between 24 September and 24 October, falling off sharply by the end of October. P. C. Petersen banded 273 ruby-crowns on 16 October 1966 near Rock Island, indicating a very large concentration. We suspect that there are occasional migration waves of ruby-crowns in November and even December, but the available counts for those months are all low (Fig. 15). The actual end of the fall migration is possibly obscured by a thin and highly variable winter population.

Ruby-crowned kinglets have been killed at central Illinois television towers with other nocturnal migrants between 20 September and 12 November, in which period they constituted nearly 1.0 percent (46 specimens) of about 4,700 specimens of all species picked up from 1955 through 1972. Ruby-crowns accounted for only 0.8 percent of the October kills, and in contrast to the golden-crown, there was no correlation between counts of kinglets killed at the towers and counts of kinglets seen in the field. Few ruby-crowns are killed on the towers in relation to the numbers seen (Graber 1968), but the reason for this may have more to do with weather than with what the birds are doing. Kills at central Illinois towers seem to be *generally* reduced in mid-October, the time of peak ruby-crown populations.

The ratio of our spring (March–May) to fall (September–November) counts of ruby-crowned kinglets was 1.0 to 2.8 for the state as a whole, but the ratio declined progressively from northern Illinois (1:3.4), to central (1:2.9), to southern Illinois (1:1.7). This is a pattern we have observed in a number of species, including the golden-crowned kinglet, and is probably indicative of an elliptical migration route which brings different populations through the state in the spring and fall (Graber 1968). The only published band recovery we've found (Bent 1949) which indicates flight direction was that of a ruby-crown banded 18 April 1937 at Waukegan and recovered 10

Fig. 16.—Winter records of the ruby-crowned kinglet in Illinois. Heavy horizontal lines separate the three regions of the state.

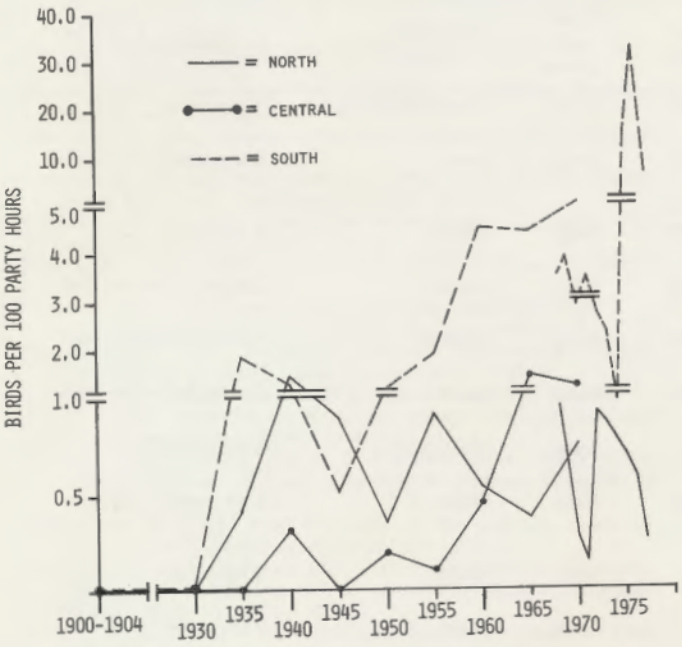

Fig. 17.—Ruby-crowned kinglets seen per 100 party hours on Audubon Christmas counts in the three regions of the state. Each point represents a 5-year average (e.g., the point for 1935 represents the counts for 1935–1939). Annual variation in the counts for the last 10 years is shown for the northern and southern regions.

days later at Green Lake, Wisconsin (about 70 km NNW).

Winter Populations

Prior to about 1930 there were very few records of ruby-crowned kinglets in Illinois in midwinter (Roberts 1922, Ford et al. 1934, Carpenter 1935). Note that most of the records shown in Fig. 16 are relatively recent. Ridgway (1874) noted that the species sometimes wintered in southern Illinois, but later (Ridgway 1889) made no mention of the species in winter. In B. T. Gault's extensive notes (1875–1927) on northeastern Illinois, we have found no winter record of the species. After 1930 ruby-crowns were detected with increasing frequency on the Christmas counts in southern and central Illinois but not in the north (Fig. 17). On the average, since 1940 it has taken about 178 party hours to find a ruby-crowned kinglet on the Christmas counts in northern Illinois, 139 hours in central Illinois, and 39 hours in the south, with the time requirement declining to only 10 hours in southern Illinois in the 1970's. In interpreting such data there is always the question of whether the population increase is real or only apparent because of the increased numbers and competency of participants in the counts.

There is other evidence of an increase in wintering ruby-crowns in Illinois during this century. Alfred Gross and Howard Ray did not detect ruby-crowns in winter on the cross-country censuses of 1907, whereas we encountered the species in both 1957 and 1958—though only in shrub habitat (Graber & Graber 1963). Judging from population densities, we believe that ruby-crowns greatly prefer bottomland forest to upland forest as winter habitat (Table 5). This preference is in contrast to that of the golden-crowned kinglet, which was as prevalent in upland as bottomland tracts. No characteristic that we measured in 15 different forests was correlated with kinglet populations (see under golden-crowned kinglet—Winter Populations). Shrub areas, with densities of 2 ruby-crowns per 40.5 ha in 1957–1958, would seem to be an important winter habitat, but the highest population we've measured was 7 birds per 40.5 ha in mature bottomland forest (Union County Refuge).

The blizzard of January 1977 had a devastating effect on the populations of kinglets, virtually eliminating both species in Illinois. Ruby-crowns showed relatively stronger recovery than golden-crowns by the following year (Table 5). In general, ruby-crowns winter much farther south than do golden-crowns (Fig. 8 and 14), and we would expect more ruby-crowns to survive and reproduce.

Our census data show a pattern of alternate-year highs in the ruby-crown population, with average densities in mature bottomland forest of 0.2 bird per 40.5 ha in (January) 1974, 2.1 in 1975, 0.2 in 1976, 1.3 in 1977 (before the blizzard), and 1.0 in 1978. The highs occur in the odd-numbered years, as in the case of the red-headed woodpecker *(Melanerpes erythrocephalus)*, a species (of very different food habits) which also favors bottomland forest in the south. The run of years for which we have data is still too short to be conclusive, especially in view of the relatively high ruby-crown population in 1978. Christmas count data do not show the alternate-year pattern (Fig. 17), but in general we find the Christmas data to be insufficiently refined to show such patterns. The Christmas counts show no correlation with our census data.

Food

See golden-crowned kinglet account.

Specimen Data

We have examined only 12 specimens (3 spring males, 2 fall males, 4 spring females, 3 fall females). They fall within the range of color and size variation of *Regulus c. calendula*. A winter specimen from northern Illinois was also considered to be of the nominate race (American Ornithologists' Union 1957). We have weight data on five specimens: September

TABLE 5.—Winter populations of ruby-crowned kinglets in various Illinois habitats.

Habitat	Hectares	Birds per 40.5 ha	Years (January)	Type of Census	Region or County	Reference
Urban residential	173	0	1976, 1978	Strip	North & Central	This paper
Urban residential (before blizzard)	106	0–1 (avg 0.4)	1976–1977	Strip	South	This paper
Urban residential (after blizzard)	167	0	1977–1978	Strip	South	This paper
Forest (all types, including edge)	18	0	1957–1958	Strip	North	Graber & Graber 1963
Forest (all types, including edge)	62	0	1957–1958	Strip	Central	Graber & Graber 1963
Forest (all types, including edge)	85	0	1957–1958	Strip	South	Graber & Graber 1963
Mature bottomland forest (1 year after blizzard)	60	0	1978	Strip	Piatt (C) [a]	This paper
Mature bottomland forest (before blizzard)	644	0–7 (avg 0.9)	1974–1977	Strip	South	This paper
Mature bottomland forest (after blizzard)	186	0	1977	Strip	South	This paper
Mature bottomland forest (1 year after blizzard)	306	0–5 (avg 0.5)	1978	Strip	South	This paper
Mature upland forest (1 year after blizzard)	81	0	1978	Strip	Piatt (C)	This paper
Mature upland forest (before blizzard)	341	0–3 (avg 0.3)	1974–1977	Strip	South	This paper
Mature upland forest (after blizzard)	91	0	1977	Strip	South	This paper
Mature upland forest (1 year after blizzard)	176	0	1978	Strip	South	This paper
Shrub area	41	2	1957–1958	Strip	South	Graber & Graber 1963

[a] C refers to the central region of Illinois, as shown on winter distribution maps, e.g., Fig. 10.

male, 6.3 g; May female, 7.4 g; three September–October females, 5.4, 6.5, and 5.8 g.

Mortality

It is difficult to imagine any mortality factor more serious than severe winter weather (see Winter Populations). Montgomery (1956) described the symptoms of DDT poisoning in ruby-crowned kinglets following spray treatment of city trees for elm disease in Elmhurst. Dyke (1961) reported the same type of mortality for the golden-crowned kinglet at Princeton.

The ruby-crown was also recorded as the prey of a saw-whet owl (Graber 1962), but in general, the specific controlling factors of kinglet populations are unknown.

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