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A BIOECOLOGICAL STUDY OF THE BLACK-CAPPED VIREO

(*VIREO ATRICAPILLUS*)

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A BIOECOLOGICAL STUDY OF THE BLACK-CAPPED VIREO

(VIREO ATRICAPILLUS)

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A BIOECOLOGICAL STUDY OF THE BLACK-CAPPED VIREO (*VIREO ATRICAPILLUS*)

CHAPTER I

INTRODUCTION

A study of the black-capped vireo (*Vireo atricapillus*) was undertaken to learn more of this little known species, and to learn why it appears to be so limited in its distribution. To accomplish this, the habits of the bird, its habitat preferences and the environmental factors thereof, its population dynamics, and its history (as much as could be ascertained) were investigated.

The black-capped vireo was described as a new species in 1852 by S. D. Woodhouse, M.D., the physician and biologist of an exploratory expedition down the Zuñi and Colorado Rivers under Captain Lorenzo Sitgreaves of the U.S. Corps of Topographical Engineers. Woodhouse's two specimens were taken on May 26, 1851, along the Rio San Pedro in southeastern Valverde County, Texas. J. H. Clark, one of the naturalists of the Mexican Boundary Commission, collected a specimen in the same area. This specimen, now in the American Museum of

Natural History, bears the date "1850" on its label, and was described by S. F. Baird in his section on birds in the 1858 Report of the Pacific Railway Survey.

A fourth specimen was taken at Mazatlan, Sinaloa, Mexico, by Colonel A. J. Grayson in the 1860's. These four specimens were the only ones known when Coues published "Birds of the Colorado Valley" in 1878. In this year, in Comal County, Texas, the nest and eggs were discovered by W. H. Werner. There followed a flurry of articles in the Bulletin of the Nuttall Ornithological Club in 1879. In 1885, N. S. Goss found the species in Comanche County, Kansas. Some interest was taken for a while thereafter, but from the turn of the century little note was paid to the species, except for a brief study published by Bunker in 1910 dealing with the birds of Blaine County, Oklahoma.

CHAPTER II

TECHNIQUES AND MATERIALS USED

I have attempted to survey the breeding range of the black-capped vireo, making special effort to find the species in areas where it formerly occurred, where it occurs at present, and in new localities. This involved travel from Hodgeman County, Kansas, through central Oklahoma, Texas, and northern Mexico to central Coahuila. I also made observations on the bird and its surroundings on its wintering grounds in Sinaloa and Nayarit, Mexico.

Vegetational factors of the habitat were examined. I checked number, frequency, and estimated size of the woody plants in quadrats about the nests. Quadrats 50 ft. square were laid off with two 100 ft. balls of cord. Woody dominants in the wintering habitat were identified. R. R. Graber determined the age of tree samples by the ring method. The situation of nests was noted and measurements made with a 72-inch steel tape.

In studying the life history and habits, birds were captured, weighed, and banded. Birds were captured with silk

fowling nets (1½ inch mesh), and banded with #0 Fish and Wild Life Service bands and with colored pyralin bands. Nestlings were banded on the sixth or seventh day after hatching. For all weighings I used portable, triple-beam balances of 100 gram capacity and .01 to .001 g. accuracy. One juvenile was kept in captivity for six weeks. Eggs were marked with a lead pencil, weighed, and a few were artificially incubated. Observations were made at nests from home-made, cloth blinds; 6 x 30 field binoculars were used.

Stomachs were saved, and their contents identified. One hundred and seventy-five museum specimens were measured and examined for variation and molt.

Photographs were made with a 35 mm. Exakta and a 2 1/4 x 3 1/4 Crown Graphic. A few recordings of temperature were made with a maximum-minimum recording thermometer.

CHAPTER III

LIFE HISTORY

Most of the life history material was obtained in 1954. I devoted all of that year to such observations. When I began the study, I had never seen or heard the species, so I felt that becoming thoroughly acquainted with it would be my first step. I began going to the oak-cedar scrub forest of Caddo County, Oklahoma, in mid-March, 1954. I first heard and saw the black-capped vireo on April 25, 1954.

Arrival

On this approximate date of arrival, a bright, warm, spring day, I saw four males, all of which were singing spiritedly. No females were seen. On our next trip, May 4, females were present. In 1955, males were found in this area as early as April 17. A careful search failed to reveal any females on that date or on April 20 and 25. On April 30, females were observed. In 1956, beginning March 1, I made daily searches in Hays and Comal counties, Texas. Males were first observed on March 24, females on April 7, so it appears that the males regularly arrive a week or two in advance of

the females. Lloyd (1887) indicated earlier arrival of males than females, but only by a day.

Arrival dates for various localities are as follows:

Locality	Observer	Date
Bandera County, Texas	Ragsdale (Cooke, 1888)	March 19
Kendall County, Texas	Brown (1882)	March 27
Kerr County, Texas	Lacey (1911)	March 19 (earliest) March 24 (average)
Travis County, Texas	Shipwash (Kincaid, 1954)	March 13 (earliest)
	Simmons (1925)	Late March
Dallas County, Texas	Kelley (1935)	April 1
	Stillwell (1939)	April 9 (earliest)
Cooke County, Texas	Ragsdale (op. cit.)	April 17
Comanche County, Kansas	Goss (1885)	Late April

These records indicate a gradual movement northward in March and April, the northernmost localities being reached by the last of April.

Territories

On arrival, the male establishes a territory, and this remains his as long as he chooses to, or can, defend it. Observations of banded birds for a period of three years on a study tract in Lone Rock Township (section 18 and adjoining sections to the southeast and southwest), Caddo County, Oklahoma, indicate that male black-capped vireos are very much

attached to their territories and are not likely to move far from them.

Nine of twelve males banded in 1954 returned in 1955. Of these, four occupied identical territories for the two seasons, and five occupied territories adjoining those of the first season. One of the latter changed territories in mid-season. In 1956, I found five males that had returned to the area for the third year. Three of these maintained the same territories all three seasons, and two occupied the same territories for the last two seasons. Both of the latter had moved to adjoining territories after the first season. Four males banded in 1955 returned in 1956. Of these, three remained on the same territories they had had before, and one moved nearly half a mile, though his mate of the former season remained on their former territory. Both the bird which moved and his former mate had new mates.

Five of twelve females banded in 1954 returned in 1955. One remained on the same territory, two were on territories adjoining their former territories, and two had moved about a quarter of a mile. In 1956, I found two of the females banded in 1954. One may have occupied the same territory all three summers, though I did not see her in 1955. The other had moved to a territory adjoining her 1955 territory which in turn had adjoined her 1954 territory. Thus she had occupied three adjoining, though separate, territories in three seasons. Two females banded in 1955 returned in 1956

and each occupied the territory it had had the previous season.

The territory actively maintained by the male throughout the season includes the space in which the pairs feed, engage in all their daily activities, and nest. In some instances they leave their territories to reach watering areas shared by all. The boundaries of territories studied changed but little in three years of observation. If a territory is unoccupied, neighboring birds tend to occupy it, thus enlarging their own territories. The male that changed territories in mid-season was probably driven from his original area because he was in poor condition as the result of a foot infection. There were a few unmated males in marginal areas that moved in to gain a mate or a more desirable territory whenever chance allowed.

Territorial limits were determined by watching banded birds throughout the season and by "driving" them. I drove the males slowly to points at which they would go no farther and turned back. In some cases the neighboring male came to that place and announced his boundary. I measured some of these areas using a 100 ft. cord with which I followed straight lines across the greatest length and breadth of the territory. I measured only territories with which I was most familiar, but others did not appear to differ markedly. The measurements of five territories in 1954 were:

Breadth	Length	Area in Acres
425 feet	475 feet	4.63
390	450	4.03
376	478	4.12
300	500	3.44
200	561	2.57

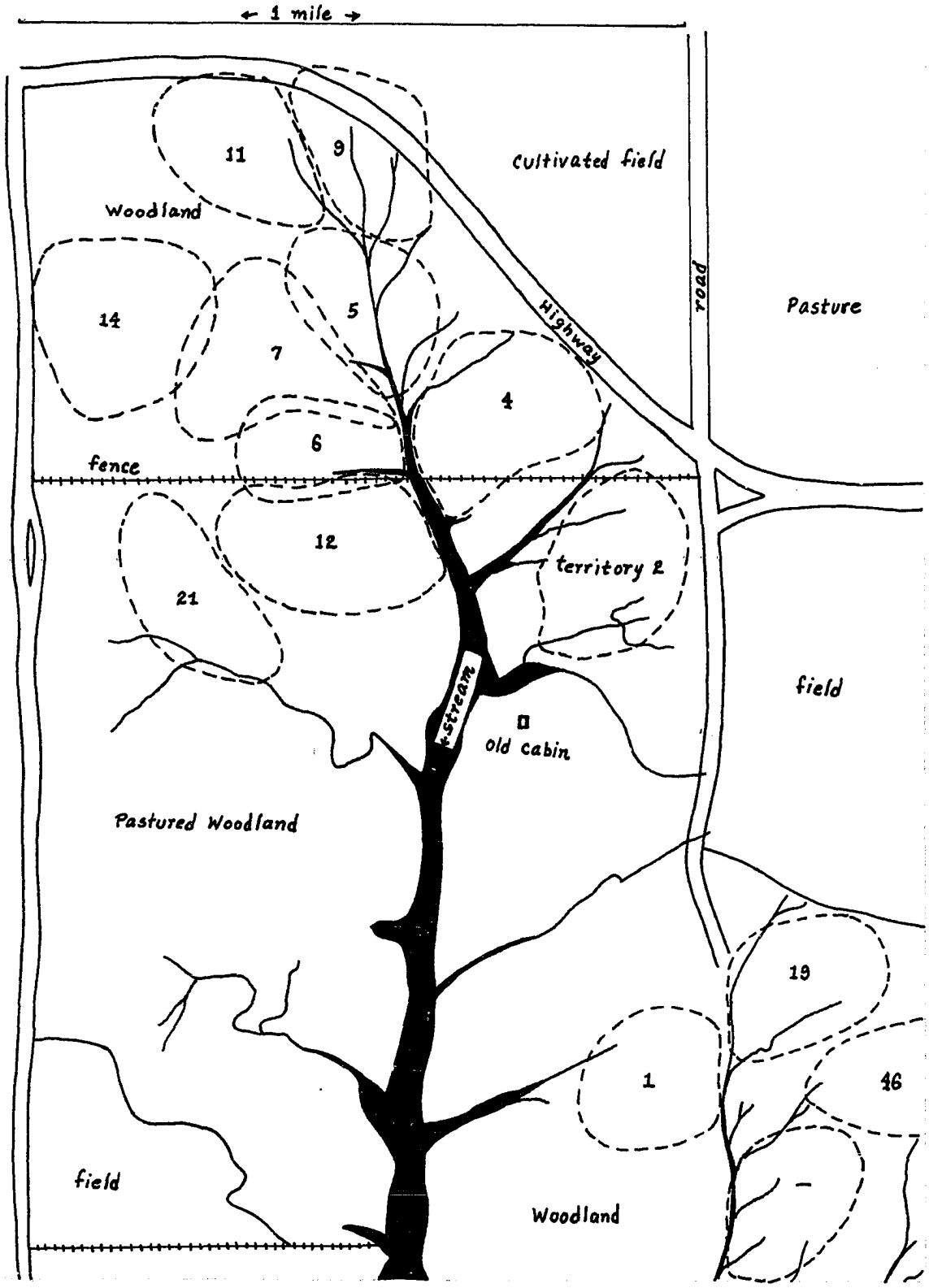
These measurements are only approximate because of the roughness of the terrain. Territories in other localities in similar habitat (oak-cedar scrub) appeared to be about the same size. Territories in burnt-over, mixed-deciduous scrub seemed to be slightly larger. Hensley (1950) found the territory of a pair of Bell's vireos (Vireo bellii) in Illinois to be 3.1 acres in size.

Map I plots the territories in the study area. These form a mosaic about the canyon heads, and this, I am convinced, is because the tree growth in such places is of the proper size and kind. Bunker (1910) expresses this same idea, namely, that the bird chooses not the lay of the land, but the vegetation.

The chief means of maintaining a territory is song, boundaries being established and the presence of the male announced to females thus. Conflicts between males may occur before the females arrive, but those that I have witnessed took place after nesting had started. I have never seen any more violent action taken than that of flying (pouncing) at each other and chasing. There is a special territorial song —a rapid, bubbling song, much like (if not the same as) the

MAP I

TERRITORIES OF BLACK-CAPPED VIREOS IN THE COGAR, OKLAHOMA, STUDY AREA, 1955 - 1956



courtship song but usually louder. Both courtship and territorial songs may well be the result of the agitation felt by the singer at such times.

The following are descriptions of conflicts between birds: Two males approached each other singing the regular song and occasionally scolding until one was perched five inches above the other on a dead limb in the top of an oak. The first male quivered his wings and sang the territorial song. The male below also sang the territorial song, and moved his head from side to side in a reptilian manner, holding his mandibles open. After half a minute, both birds left, each going to his own grounds. The scold notes used were different from those the species used toward human intruders. One note was a high-pitched "scrief," the other a sharp "chit-chit-chit." The first male used both, the second gave only the "scrief" as he approached.

R. R. Graber saw an interesting encounter. Two neighboring males were singing regular songs as they flew from tree to tree, gradually approaching each other. Finally they confronted each other in two dead blackjack oaks about 100 feet from the nest of one of them. When they were about four feet apart and about the same distance above ground, they began singing territorial songs. As they hopped about the branches, moving slowly closer, they flicked their wings, singing furiously all the while. When they were about two feet apart, one flew into the tree of the other, and the

latter darted at the invader making a small circle about him. They both returned to their own trees for a moment, and the whole affair was repeated with an interchange of roles. Then, while continuing territorial song and flicking the wings, each withdrew toward his own territory, and began singing occasional phrases of the regular song. When about 15 to 20 feet apart, they were singing regular songs entirely.

In another instance, a male chased a stranger (unbanded male, new to area) about 200 yards from the young birds the former was feeding. While the two adult males were carrying on a vocal battle from tree to tree, a third male joined the fray, so that at one time all three were singing only a few feet apart.

On another occasion, a male while feeding his fledglings wandered into a territory adjoining his own. He saw me and scolded. The proprietor of the territory appeared, and both males scolded me. One of the juveniles came near, and its parent caught an insect, but at the same time decided to attack the other male which was quite close to the young bird. He chased the bird away, carrying the food all the while, then returned and fed the juvenile.

The first mate of a female who chose the male of an adjoining territory for her mate upon starting a second brood, often came to the edge of their territories and engaged in dispute with the male who had stolen his mate away. He was probably trying to follow the female to her second nest not

far away, and was halted by her "new" mate at the territory boundary.

I have never observed a conflict of any sort between two females or between a male and a female.

Pair Formation

Pairs were formed immediately upon arrival of the females. The female appeared to choose the male and territory together, mating with a male on or near the area to which she became attached. Pairs appeared rather stable. Changes occurred when one of the pair failed to return to breeding grounds after winter, when one or the other was incapacitated by an accident, or when a male was occupied with caring for the first brood and a nearby male was available for starting the second brood.

Twelve pairs were banded in 1954. The only female that I know to have been double-brooded changed mates between broods. In 14 re-nesting attempts involving six pairs, only one pair changed mates, this exchange involving the double-brooded pair. I know of two pairs that were double-brooded in 1955, and both remained mated for the second brood. In seven re-nesting efforts, involving six pairs, only one pair changed mates. I believe that pairs remain mated throughout a season because re-nesting and starting of second broods begin at different times, and therefore only the two birds involved are likely to be at the same stage in the

reproductive cycle. The members of only two pairs survived three seasons. One pair I know were mated in 1954 and 1956, and probably in 1955, though I did not see the female that year. The other two remained mated for two seasons, through a total of at least three nestings, but separated the third season. Two pairs returned in 1956 for their second season, and one remained mated; the other changed mates.

Courtship and Copulation

Courtship consists of song and display. I observed courtship by song far more often than that involving display. There is a special courtship song which is made up of a series of low, rapid, bubbling notes, entirely lacking the characteristic phrasing of the regular song. The male follows the female about the territory singing to her. Often I have watched the female alight, then the male about a foot away from her, commencing his courtship song.

In one courtship flight I witnessed, the male flew in a downward arc from a perch 30 feet high to a perch three feet high, fluttering his golden-tinted wings and exposing his brilliant back while singing the courtship song before the female who was perched near the point of his departure. She then flew to where he alighted. In another instance, the male fed a juvenile of the pair's first brood, then he left his perch in pursuit of the female. Both birds gyrated about the sky some 40 feet up, the male following the female closely,

but never quite catching her. Chipping sounds ("tup, tup, tup") were given during the flight, then the male alighted and sang a courtship song.

One display which immediately preceded copulation consisted of several short fluttering flights about a foot above the perched female, while singing the courtship song. These flights may have been attempts to mount the female. The two times I watched copulation, the female was perched about eight feet up in a tree. The male hovered over her, then settled lightly on her back for a moment. Copulation took place in mid-morning both times.

The Nest Site

The male covers his territory thoroughly before the arrival of the female, and while doing so he looks for nest sites. In fact, I have seen a male build the rim of a nest during this time. I have watched males go to a likely-looking crotch and examine it carefully, even circumscribing an arc with the head between the branches as if weaving fibers or measuring the width between them. I have also seen a white-eyed vireo (Vireo griseus) do this same thing.

When the female arrives, the pair wanders about the territory looking at nest sites together. I suspect that the female makes the choice, for I saw a pair examine a crotch to which the male had already attached a few wisps of spiderweb, but they began building the next day at another site. Too, I

saw a female building a nest for a second brood by herself while the male cared for the first brood. I know, also, of two unmated males that selected typical nest sites and built the rims of nests but never finished them. One of these built two nest rims during the summer. The completion of a nest appears to require the attention and efforts of the female.

I watched one pair looking for a nest site. Both flew down to and inspected the forked end of a certain small branch of a blackjack oak. The male tried repeatedly to pull off a small dead twig that stuck into the opening of the crotch. R. R. Graber observed another pair behaving in the same manner. This pair went into two separate clumps of oaks and looked at sites. They peered at the crotches closely, sometimes nibbling at the twigs.

The nest is generally placed almost as far out on the branch as it is above the ground. The average distance from the trunk to the nearer edge of the nest was 29 inches and the average height (ground to the rim of the nest) 35.1 inches in 52 Oklahoma nests. In 25 Texas nests, these measurements were 28.8 and 45.7 inches respectively. Frequently a nest is built in a shoot. The average distance from the tip of the branch in 83 Texas and Oklahoma nests was 5 inches, the greatest distance being 13 inches.

The height of 67 Oklahoma nests ranged from 18 to 66 (average, 34.5) inches. That of 34 Texas nests in 1956

ranged from 27 to 74 inches (average, 44.0). Simmons (1925) gave nesting heights in Texas as two to six feet, rarely 15, usually four. Five nests in central Coahuila, Mexico, were one to two feet above the ground. Nests placed in Spanish oaks in Texas had an average height of 59.6 inches. The deer browse line on these trees was just a little under five feet. Nests in the same area in cedars, which are never browsed, had an average height of 39.7 inches. The size of the tree or shrub probably also affects the location of the nest.

In 70 Oklahoma nests examined by me, six species of trees were chosen for nesting:

Species	Number of Nests
Blackjack oak (Quercus marilandica)	51
Post oak (Q. stellata)	12
Chinquapin oak (Q. muhlenbergii)	3
Buckeye (Aesculus glabra)	2
Redbud (Cercis canadensis)	1
Poison ivy (Rhus toxicodendron)	1

I found one old nest in a Red cedar (Juniperus virginiana) which I am certain was that of a black-capped vireo.

In 37 Texas nests, the species of trees chosen for nesting were:

Species	Number of Nests
Spanish oak (Quercus texana)	12
Evergreen sumac (Rhus virens)	11
Mountain cedar (Juniperus ashei)	9
Sumac (Rhus lanceolata)	3
Live oak (Q. virginiana)	1
White oak shinnery (Q. breviloba)	1

Of five nests found in central Coahuila, Mexico, four were in scrubby oak (Quercus sp.), one in madrono (Arbutus texana). Nests have been found also in elm (probably Ulmus americana) (Goss, 1885); dogwood, wild plum, chinaberry (Bunker, 1910); mesquite (Davie, 1898); and elm (probably cedar elm, Ulmus crassifolia) (Simmons, 1925). An unusual nest site in a pine was described by Singley (1887).

Certain nest sites are used repeatedly by black-capped vireos, for I have found an old nest of the previous season on the ground beneath occupied nests on several occasions. I have observed males burst into courtship song as they hopped about old nests. One unmated male regularly visited an old nest and sang courtship songs in the tree above it. Finally the old nest fell, and he built a nest rim in the same crotch. Two sites were used for at least three years in succession. While the sight of an old nest definitely stimulates the birds, the location itself may be attractive. In 1954 I removed a nest and its crotch; the

following year a different pair of vireos built in the same tree in a crotch near the site of the 1954 nest.

The suggestion has been made (Bunker, 1910) that the nest of the black-capped vireo is placed in the center of a clump of bushes, while that of Bell's vireo is placed at the edge. In 31 of 70 Oklahoma nests, and 25 of 38 Texas nests, the nest was placed in the center. In the remaining 52 nests (13 Texas, 39 Oklahoma) the nest was placed at the edge. I have seen a number of Bell's vireo nests that were in the center; therefore this does not seem to be a very good way to distinguish between the two.

The Nest

The nest is a cupped, pensile structure, typically vireonine. Brewster (1879), Goss (1885), Davie (1898), Bunker (1910), Simmons (1925), and Morse (1927) give descriptions of nests. Average measurements of 45 Oklahoma nests are:

Dimension	Used Nests (18)	Unused Nests (27)
Outside depth from rim to bottom	6.24 cm.	5.86 cm.
Largest outside diameter at rim	5.52	5.93
Thickness of wall at rim (greatest)	0.92	1.11
Inside depth from rim to bottom	3.90	3.72

Used nests are those from which young have fledged or those which have been occupied for some time. Unused nests are those in which there have been only eggs. I made this

distinction to allow for distortion of the shape by the growing young birds in the nest. It appears that such distortion is an elongation produced by the weight of the young birds.

Many nests are very compact with felted walls which become hard like paper mache when weathered. While some are rather thick, many are quite thin at a point just below the rim and pull apart at this point when there is much weight in the nest as is the case when there are two cowbird chicks in the nest. The nests vary in shape and can be described as urn-shaped, spherical, or cup-shaped. The outside often has a peculiar mottled appearance. As yet no one has given a good means by which to distinguish the nests of Bell's and black-capped vireos, and I find that I cannot tell them apart with certainty, though this may be easier in places where the habitats of the two species do not overlap.

The materials used in construction of nests were dead leaves, dried grasses, plant fibers, cottony plant substances, cedar bark, paper, wool, and spider-web or similar substances (caterpillar silk). The chief construction materials in nests built in oak-cedar habitat were cedar bark and oak leaves which were bound together with spider-web. In areas where there are no cedars, grass and grapevine bark were used instead of cedar bark. In Mexico, the dried, paper-like leaves of yucca were used. Thus the structure of the nest reflects the nature of the habitat. Bits of paper, spider cocoons, or other white, tissue-thin materials are often

placed decoratively on the outside of nests. The sparse lining is of fine grass stems and panicles.

Nest Construction

The materials for the nest are for the most part gathered nearby. I have watched both members of pairs go to cedars close to nests they were building and pull small strips of bark from the lower, almost horizontal branches. I have seen one female fly down and pick up a dead leaf from the ground not ten feet from the nest site. I have seen a male tugging at leaves on a dead branch of an oak about three feet above the ground. The nest he was starting was about 10 or 15 feet away. I have seen a pair in Texas stripping bark from a mustang grape about ten feet from their nest site. One male on my study area in Oklahoma carried a piece of tissue paper up into a cedar. There he tore off small pieces and carried them to the nest about thirty feet away. R. R. Graber and I have both watched females gathering spider-web from the topmost branches of dead oaks which were close to their nests.

The length of time required for completion of the nest varies with the pair and the season. First or early summer nests are usually completed in four or five days. Later nests and those for re-nestings are usually more rapidly built. In one case, the total time lapse between the loss of hatchlings and the laying of the first egg in the third nest

was five days. The longest time observed between the beginning of building and the laying of the first egg was 16 days. The period between the completion of the nest and laying of the first egg is usually a day.

Although both sexes work at building the nest, the female accomplishes more since the male pauses to sing and defend his territory. Some males appear to be rather inefficient at building. I observed one whose contribution toward building was to bring a bit of material to the partly finished cup and just drop it in. I have seen some females carry great mouthfuls (many pieces) of material to their nests.

I observed one pair from 12:00 noon to 1:00 p.m. working on a half-built nest and found that they made 22 trips with nest material. The male made eight trips, the female 14. The male came and sat on the nest twice without bringing material, the female did this once. The male sang short snatches of song as he worked. Sometimes he merely accompanied the female as she got material and brought it to the nest. I never saw him work at weaving with his bill as did the female. He limited his building to sitting in the nest and turning about, fitting it to his body.

Bunker (1910) described the beginning of the building of a nest. He said the bird attached fibers to the twigs making a fringe, then it flew down, caught up a fiber in its bill, and flew to the opposite side of the crotch to attach it. I have never observed this stage of nest building, for

if I remained in the vicinity of a barely-started nest, the birds invariably deserted. Most of the nests I watched were already a shallow platform of fibers, and as material was added the birds sat on the nest, shaping it and making it deeper by stretching the loosely connected network. After a slow start (in terms of the amount of structure made), the birds build rapidly for a day or two, adding the bulk of the nest, then adding the lining slowly. Nests are never re-used; a new nest is built for each clutch. Four nests are the most I have seen any one pair build in a season.

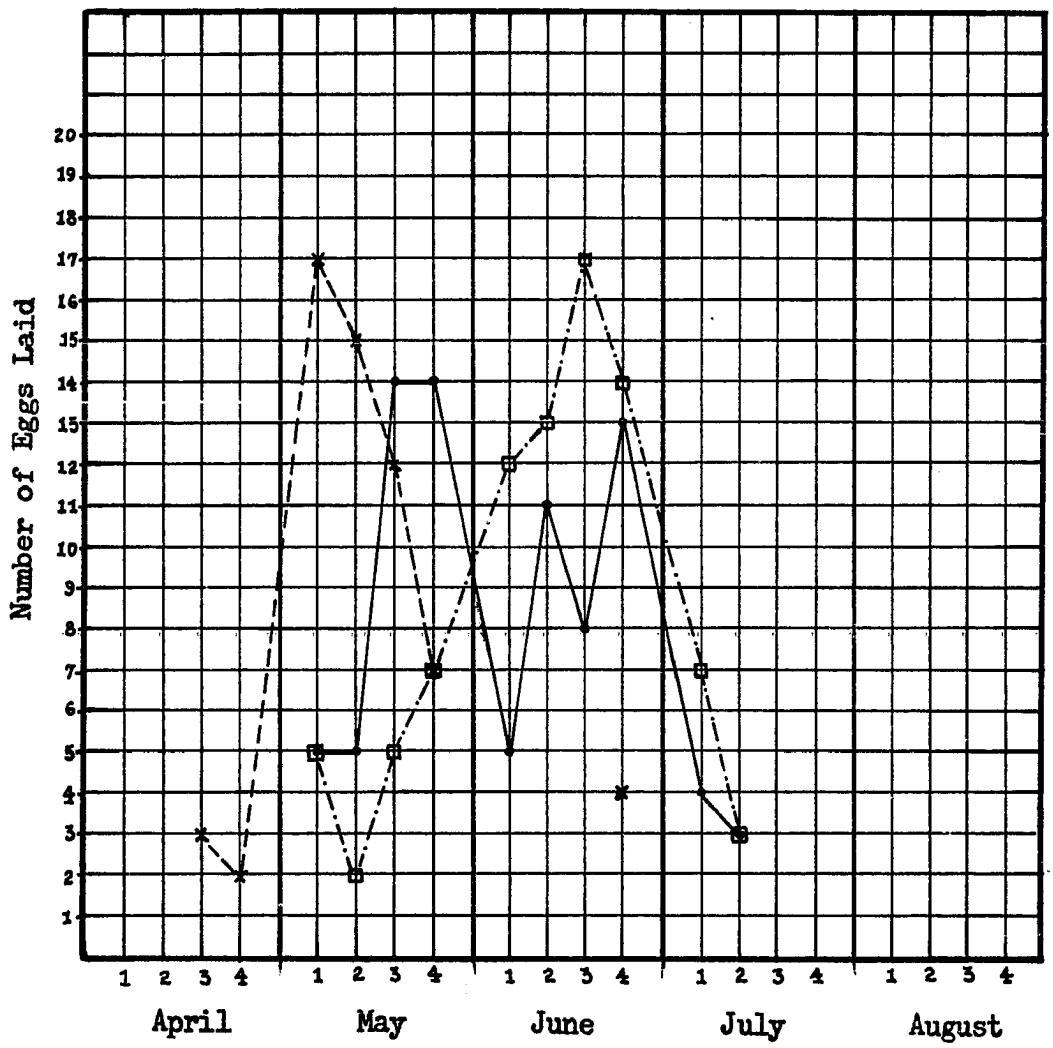
Laying

Graph I pictures the laying of eggs in nests under observation. I found eggs hatching as early as April 23 in Hays County, Texas. In Caddo County, Oklahoma, the first eggs were laid in late April and early May.

I made an effort to determine the time of laying for four different females, and found that they laid at about 6:00 a.m. in June in central Oklahoma. In each case, the daily procedure during egg-laying was much the same. The singing of the male, at about 5:00 a.m., was the first evidence of activity of the pair. The male came toward the nest, but never went down to it. The female came to the nest a little later (10 to 20 minutes before laying) and got on it. In laying, the female, having been sitting rather deep in the nest, rose up, arched her tail downward, pushed her

GRAPH I

COMPARATIVE DATA SHOWING EGG LAYING ACTIVITY DURING DIFFERENT WEEKS OF THE LAYING SEASON IN OKLAHOMA AND TEXAS



------ Texas, 1956

-.-.-.- Oklahoma, 1954

——— Oklahoma, 1955

vent toward the bottom of the nest, while her foreparts rose out of the nest, and appeared puffed out. After a few seconds, she settled again. Upon flushing her, I found the new egg not yet dry. If left undisturbed, she continued to sit on the nest for 20 to 40 minutes before leaving.

Both birds sit on the nest during at least part of the day on which the first egg is laid. I watched one nest from 5:30 to 10:35 a.m. The female got on the nest at 5:45, laid at 5:57, and remained until 6:30. After a brief absence she returned to sit on the nest for a total of one hour and 46 minutes (intervals of 31, 12, 33, 15, and 15 minutes); the male was on for one hour and 27 minutes (intervals of 1, 31, 18, and 37 minutes); and the nest was unattended for two periods (19 and 17 minutes). I have seen other black-capped vireos on their nests after the laying of the first eggs, but they did not spend the night on the nest until the second or third egg had been laid. So I have counted incubation as starting on the day preceding the first night spent on the nest. It would seem that this procedure would be detrimental to development, but it does not appear to be so. Experiments have indicated that pheasant eggs can tolerate exposure to temperatures as low as 45°F. for periods up to eight hours during the first two weeks of incubation without lowering hatching success (MacMillan and Eberhardt, 1955). I think the habit of daytime covering of the eggs as soon as they are laid has survival value for the black-capped vireo in that in

this manner they are safeguarded from cowbirds (Molothrus ater).

I watched one female lay three eggs, finding that she laid egg #1 at 5:57 a.m., egg #2 at 6:05-08 a.m., and egg #3 after 6:14 a.m. (the male was on the nest until then). In every case I have observed, laying has occurred on consecutive days.

The Clutch

Four eggs usually comprise a clutch. In 45 nests, there were four eggs; in 26, there were three. However, in some nests holding three eggs, four eggs may have been laid, one having been removed before I checked the nest. I found no indication that clutch size in the north was larger than that in the south. I have never found a nest with more than four eggs. If an egg is removed during laying, the clutch may be completed, but it will consist of no more than three eggs. If more than one egg is removed, usually the nest is deserted, unless cowbird eggs replace the loss. I have records of seven second nests containing four eggs, and of only one containing three. In one case, both the first and second clutches consisted of three eggs. In 1954 in four nestings one female laid clutches of four, two (interrupted by cowbird), two (interrupted), and three eggs (total: 11 eggs). In 1955 she laid three four-egg clutches. She weighed 9.45 grams in 1954, and 9.50 g. in 1955, so that in both seasons she laid

very nearly twice her own weight (egg weight: about 1.5 g.).

The Eggs

I have seen a total of 285 eggs in 83 nests from northern Oklahoma to central Coahuila, Mexico, and all have been immaculate white. The egg is similar to that of the Bell's vireo, but more pyriform. Bent gives the average measurements for 50 black-capped vireo eggs as 17.6 x 13.1 mm. with extremes of 19.3 x 12.7, 18.8 x 14.7, 16.0 x 12.7, and 16.7 x 12.2 mm. I have measured only six eggs and they fell within these measurements except for one which measured 17.2 x 11.8 mm.

The average weight of 21 one-day-old eggs from six different females was 1.59 grams. The eggs lost weight throughout incubation so that by hatching time they weighed only 1.1 to 1.3 grams. This gradual weight-loss was about the same from day to day in artificially incubated eggs. It was irregular in the nests, suggesting that the habits of the birds and the weather may have affected it. A Bell's vireo egg lost more weight during incubation in a black-capped vireo nest than did three black-capped vireo eggs in the same nest, but lost less weight than did three other eggs of the same clutch in the parent Bell's vireo nest. A black-capped vireo egg lost less weight during incubation than did three Bell's vireo eggs in a Bell's vireo nest, but lost more weight than did three other eggs of the same clutch in the parent

black-capped vireo nest. This difference may have lain in incubation habits, in nest situation, or in the eggs (possibly the porosity of the shell). Both transposed eggs hatched and the young were reared by the foster parents.

Incubation

Incubation begins with the laying of the second or third egg. One female started incubation with the second egg of a four-egg clutch, another with the third egg of a three-egg clutch. Both of these were re-nestings. From the sequence of hatching, it appears that incubation often starts with the second egg.

Both sexes incubate. The male lacks a definite brood patch, though in a few individuals I have noticed a slight bareness in the abdominal region. The females have a large brood patch measuring about 15 x 30 mm., which becomes highly vascularized after four or five days of incubation, and flaccid and yellow after eight or ten days of incubation, then returns to normal appearance. There seems to be considerable variation in the condition of the brood patch, and this variation may depend on whether or not the bird has incubated before and if so, for what period. One female that was laying showed no brood patch, and another showed vascularization. I have caught a female two days after her eggs had hatched, and she still had a large, slightly vascularized, slightly flaccid brood patch.

I watched one nest for 15 hours continuously on the first day after the clutch was completed (on the fourth day of incubation), and again on the 14th day of incubation (two days before hatching), to see what occurred during both the early and late stages of incubation. On both days, incubation was shared by the male and female, but since the female spent the nights on the nest, she actually accomplished about two-thirds of the incubation. Tables I and II summarize the data obtained.

On the fourth day of incubation, the longest inattentive period occurred in mid-day (11:16-11:30 a.m.) and was 14 minutes in duration. Attentive periods ran about 20-40 minutes in the morning and were longer in the afternoon. During the cooler parts of the day, the birds sat deep in the nest, but in the heat of the day they sat high, apparently thus varying the temperature of the nest contents. Late in the afternoon the wind arose, and the nest was jostled considerably but the incubating bird sat tight.

On the 14th day of incubation, the longest inattentive period was 10 minutes. Attentive periods were shorter than on the fourth day but total attentiveness was slightly more. The nest was left unattended for 5.7% of the time observed as compared with 11.4% on the fourth day. Part of this difference may be accounted for by assuming that the birds were more disturbed by my activities and by the blind at first than they were later.

At this nest and at others that I have observed, there was a definite pattern of behavior during the change-over of birds at the nest. Usually the male sang a phrase or two of the "nest song" as he approached and the female replied with a soft "shrade" and left the nest. On returning the female again gave a soft "shrade" and the male left, singing a phrase or so as he went. Once in a while he sang just before leaving, but such songs certainly can not be compared with those given by warbling vireos (Vireo gilvus) on their nests. One female that I watched tending a nest alone (the male was caring for the first brood), announced her approach to the young by an unmusical phrase or two. While she was incubating, the male often came to the tree with the first brood and called her off the nest, and she left and returned with a soft "shrade."

Both birds roll the eggs from time to time with their bills while sitting or just before settling on them.

The male apparently does not incubate eggs of the second brood, being occupied with the care of the first brood. In one case in which I have data on the second brood of a banded pair, the female took another mate to help her with the second brood; in another case the female undertook the task by herself. I have observed other females (unbanded) carrying out incubation by themselves while what I took to be their mates cared for young probably of the first brood. Table III summarizes observations made of the female (above)

TABLE I

OBSERVATIONS OF NEST (N2) ON FOURTH DAY OF INCUBATION

Time	Minutes Bird on Nest: Male	Minutes Bird on Nest: Female	Minutes Nest Unattended
5:00-5:33 a.m.			33
5:33-5:52		19	
5:52-6:17	25		
6:17-6:55		38	
6:55-6:56			1
6:56-7:35	39		
7:35-8:03		28	
8:03-8:36	33		
8:36-8:37			1
8:37-8:40		3	
*8:40-8:43			3
8:43-9:05		22	
9:05-9:44	39		
9:44-9:45			1
9:45-10:18		33	
10:18-10:23			5
10:23-11:02	39		
11:02-11:16		14	
11:16-11:30			14
11:30-12:00 noon	30		
12:00-12:18 p.m.		18	
*12:18-12:31			13
12:31-12:42		11	
12:42-1:22	40		
1:22-1:50		28	
1:50-2:51	61		
2:51-3:31		40	
3:31-4:20	49		
4:20-5:07		47	
5:07-6:03	56		
6:03-6:08			5
6:08-6:23		15	
*6:23-6:37			14
6:37-7:10		33	
*7:10-7:23			13
7:23-8:00		37 (still on when observations ceased.)	
Total Time	411	386	103
Number of Periods	10	15	11
Average Time for a Period	41.1	25.7	9.3

*Bird disturbed by observer.

TABLE II

OBSERVATIONS OF NEST (N2) ON
FOURTEENTH DAY OF INCUBATION

Time	Minutes Bird on Nest		Minutes Nest Unattended
	Male	Female	
5:15-5:20 a.m.	...(5:17 male first heard).....		5
5:20-5:39		19	
5:39-5:40	.....		1
5:40-5:55		15	
5:55-6:20		25	
6:20-6:44		24	
6:44-7:01		17	
7:01-7:02	.....		1
7:02-7:27		25	
7:27-7:49		22	
7:49-8:14		25	
8:14-8:41		27	
8:41-8:42	.....		1
8:42-9:18		36	
9:18-9:36		18	
9:36-9:38	.....		2
9:38-9:57		19	
9:57-10:08		11	
*10:08-10:13	.....		5
10:13-10:17		4	
*10:17-10:18	.....		1
10:18-10:21		3	
10:21-10:26	.....		5
10:26-10:50		24	
10:50-11:06		16	
11:06-11:07	.....		1
11:07-11:15		8	
*11:15-11:22	.....		7
11:22-11:30		8	
11:30-12:02 noon		32	
12:02-12:35 p.m.		33	
12:35-1:09		34	
1:09-1:48		39	
1:48-2:18		30	
2:18-2:20	.....		2
2:20-3:01		41	
3:01-3:16		15	
3:16-3:19	.....		3
3:19-3:28		9	
3:28-4:00		32	
4:00-4:01	.....		1
4:01-4:46		45	

TABLE II—Continued

Time	Minutes Bird on Nest: Male	Minutes Bird on Nest: Female	Minutes Nest Unattended
4:46-4:56 p.m.			10
4:56-5:00	4		
5:00-5:01			1
5:01-5:14		13	
5:14-5:17			3
5:17-5:22	5		
5:22-5:45		23	
5:45-5:46			1
5:46-6:12	26		
6:12-6:51		39	
6:51-6:52			1
6:52-7:04	12		
7:04-8:00		56 (Still on when observations ceased.)	
Total Time 885	376	458	51
Number of Periods	17	20	18
Average Time for a Period	21.5	22.9	2.8

*Bird disturbed by observer.

TABLE III

OBSERVATIONS OF NEST (N41): SECOND BROOD, INCUBATION ON THIRD DAY BEFORE HATCHING

Time	Minutes Bird on Nest (Female only)	Minutes Nest Unattended
4:45-5:25 a.m.	40	
5:25-5:33		8
5:33-5:59	26	
5:59-6:12		13
6:12-6:53	41	
6:53-7:04		11
7:04-7:30	26	
7:30-7:40		10
7:40-8:30	50	
8:30-8:35		5
8:35-9:00	25 (Still on nest when observations ceased.)	
Total Time 255	208	47

that incubated the eggs of the second brood alone. She left the nest unattended 18.8% of the time that I watched it. She guarded the nest closely, never leaving its vicinity. If I could not see her and put my head out of the blind, she immediately scolded.

The total incubation period varies from 14 to 17 days. I determined the incubation period 13 times in Oklahoma and twice with artificial incubation. The longer periods occurred early in the season, and when nests were cowbird parasitized. Most of the variation probably can be explained by variation in the attentiveness of the parent birds. Some may be due to climatic influences. Attentiveness is lessened when a cowbird egg hatches, but this is not always the case, since in two nests with cowbird chicks the vireo eggs hatched in 14 days.

Hatching

The eggs usually hatch over a two-day period, indicating that incubation is started before the clutch is complete. In seven nests the second and third eggs hatched on the same day; in three nests, they hatched on different days. In one nest, all eggs (four) hatched on the same day. Hatching occurred at any time of day, and probably of night. I have seen eggs remain pipped for as long as 12 hours before hatching. The egg is pipped around its greatest circumference and the chick pushes and kicks out.

Eggshells are promptly removed from the nest. At one nest, they were carried away within 15 minutes after hatching. At another nest I watched the female remove them. She probed into the nest while perched on the rim, and finally lifted the shell up over the rim. Both halves fell to the ground, and she flew down and scooped up one half and carried it off. She must have forgotten the other half, for it remained where it had fallen. One afternoon, I found a marked half-shell about 75 yards from the nest in which the egg had hatched that morning. It was lying near the edge of the water where the vireos drank. This is the only observation I have as to where the shells may be taken when removed from the nest. I have never seen the birds eat any shells.

I have not seen the adults help the young out of the egg. Several times I have found pipped eggs on the ground near the nest. It occurs to me that the instinct to remove the shell may lead to removal of pipped eggs that are slow in hatching. This may be beneficial, for the chicks that have trouble at hatching may be weaklings.

The Newly-Hatched Chick

At hatching, the chick is naked and blind. There is not a trace of down. The eyes can be seen clearly through the transparent skin, but the lids are not opened until the second day, and then they are only half opened. The skin is yellowish pink, as are the bill and feet. The gape is yellow

and has an upward angle toward the eye. The body wall is transparent and the gut, liver, and other organs can be plainly seen. A worm fed to the chick can be seen passing from the mouth to the stomach. The chick weighs about a gram at hatching.

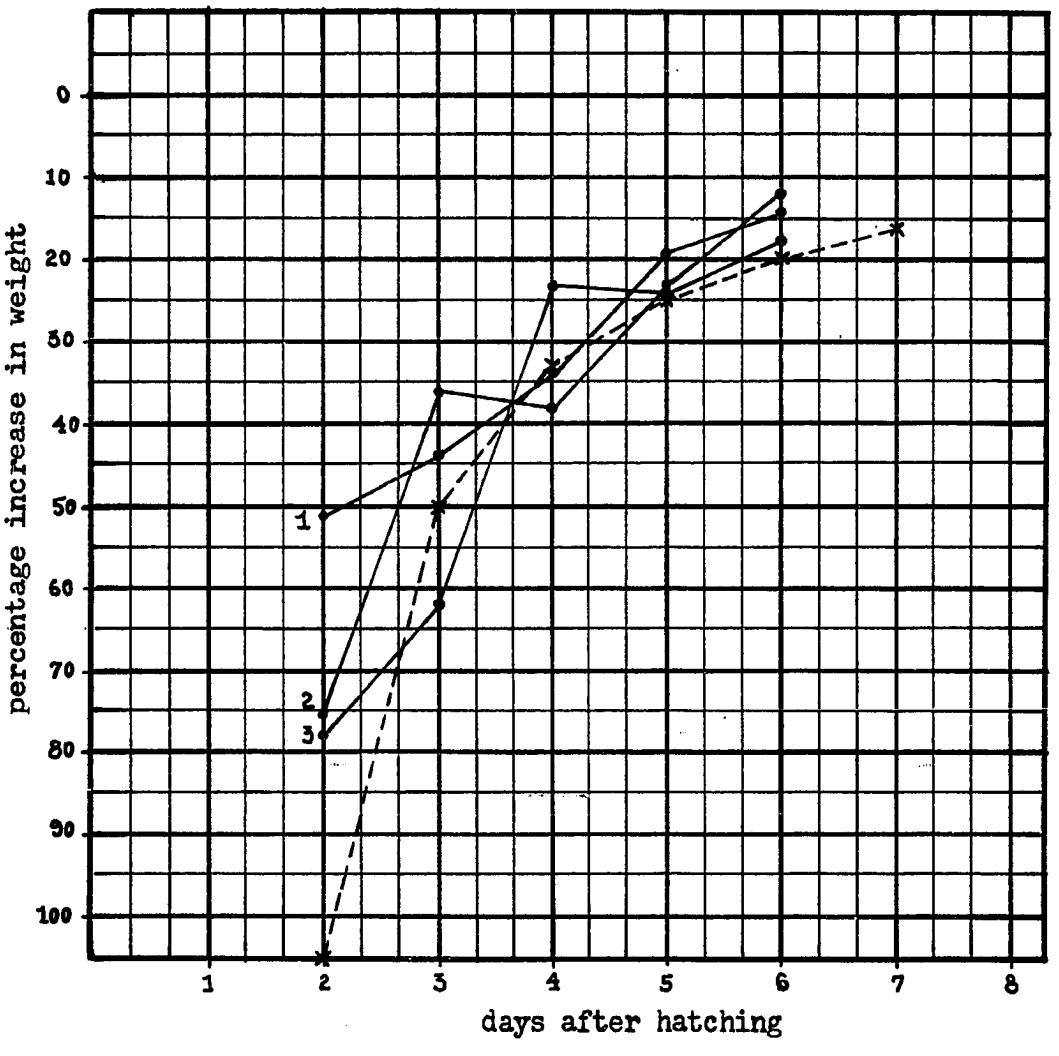
The Development of the Young Bird

The young gain approximately a gram per day until they weigh between seven and eight grams. Their weight upon leaving the nest is about eight grams. The percentage increase in body weight is greatest on the first day and diminishes in a regular progression thereafter. Graph II shows growth curves for three chicks in one nest, and a theoretical curve based on exactly 1 gram per day increase in body weight. Table IV gives results obtained from weighing nestlings daily in three black-capped vireo nests and in two Bell's vireo nests. I stopped weighing the chicks when they were six and seven days old because handling might induce them to fledge prematurely. Two black-capped vireo fledglings out of the nest for one day and two days weighed 8.1 and 6.88 grams respectively.

In an attempt to determine ecological differences between Bell's and black-capped vireos, I exchanged eggs between two nests of these species. The eggs hatched and I observed and compared the development of a black-capped vireo chick in a Bell's vireo nest with two Bell's vireo chicks and

GRAPH II

GROWTH CURVES OF N2 BROOD



1 is first chick hatched, 2 second, and 3 third. Dotted line shows theoretical curve based on 1 gram per day increase in weight.

TABLE IV

DAILY WEIGHTS OF NESTLINGS IN GRAMS

			Age in Days						
			1	2	3	4	5	6	7
Black-capped Vireos	N2	1	1.67	2.52	3.63	4.89	5.85	6.70	
	N2	2	1.42	2.49	3.40	4.70	5.80	6.47	
	N2	3	1.10	1.96	3.17	3.91	4.88	5.73	
	N56	1	1.55	2.09	2.75	3.75	5.04	6.61	
	N56	2	1.86	2.55	3.43	4.61	5.87		
	N56	3	1.68	2.35	3.10	4.08	5.68		
	N35	1*	1.23	1.85	3.00	4.53	5.10	6.15	
	N35	2		2.70	3.70	4.87	6.00	6.70	8.30
	N35	3		2.50	3.65	4.85	5.97	6.44	8.00
	N35	4		1.91	2.60	3.80	4.93	6.24	7.60
Bell's Vireos	B1	1			3.30	4.72		6.20	8.00
	B1	2	1.57	2.60			5.15	6.16	
	B1	3*	1.43	2.30	3.02	4.40			
	B2	1	1.80	2.90		4.20	4.85		
	B2	2	1.70	2.80		3.97	4.85		
	B2	3	1.60	2.75		3.50	4.63		

The first column indicates the clutch, the second the sequence in hatching. Since all nestlings in a nest were weighed at the same time, variation in weight often indicates variation in age.

* Bird reared in foster nest.

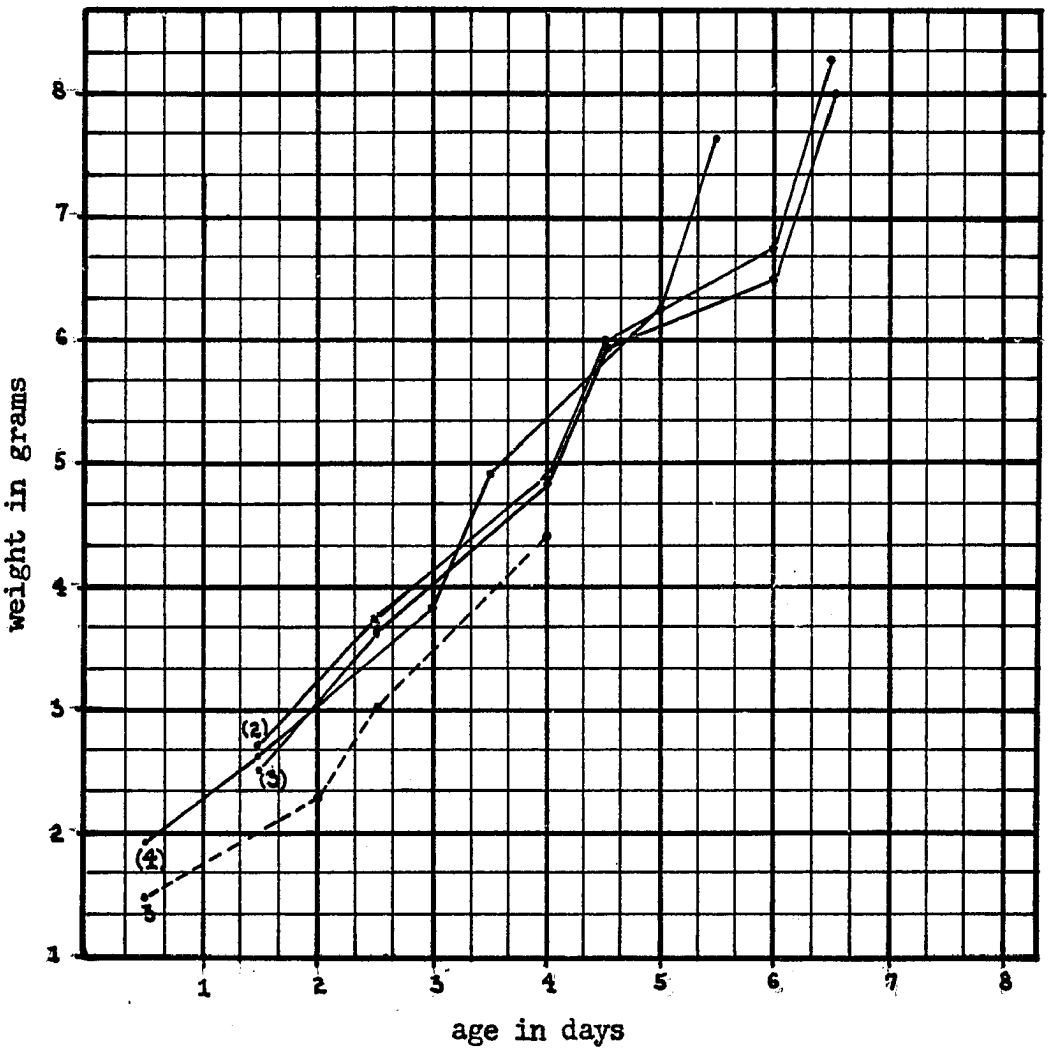
of a Bell's vireo chick in a nest with three black-capped vireo chicks. Graphs III and IV show daily weights of the nestlings. I had hoped to repeat this experiment with the white-eyed vireo, but was prevented by predation and cowbird parasitism. Both adopted chicks grew fairly well, though the black-capped chick did not do as well as its siblings or its nestmates.

The chicks of the black-capped and Bell's vireos are very much alike, neither having down at birth. The head shape is different, that of the black-capped vireo being the rounder as seen from above. The gape of the black-capped vireo at an age of one to four days is yellower, and the tip of the bill darker. The tip of the bill in Bell's vireo does not become dark until the fifth or sixth day. As soon as the wingbars become evident at the age of three days the definite, yellowish wingbars of the black-capped vireo are distinctive. From then on the plumage patterns make it easy to tell the two apart. Both have a "shrief" call, but that of the black-capped vireo is higher in pitch.

On the day of hatching, tiny blackish feather buds can be seen along the outer edge of the manus and the distal half of the forearm. No other feather buds are visible. By morn of the second day a small portion of the mid-dorsal tract shows, but no quills break through the skin until the third day. Feather buds are then visible on the capital and ventral tracts. On the latter they are hard to see because

GRAPH III

DAILY WEIGHTS OF MIXED BROOD IN
BLACK-CAPPED VIREO NEST

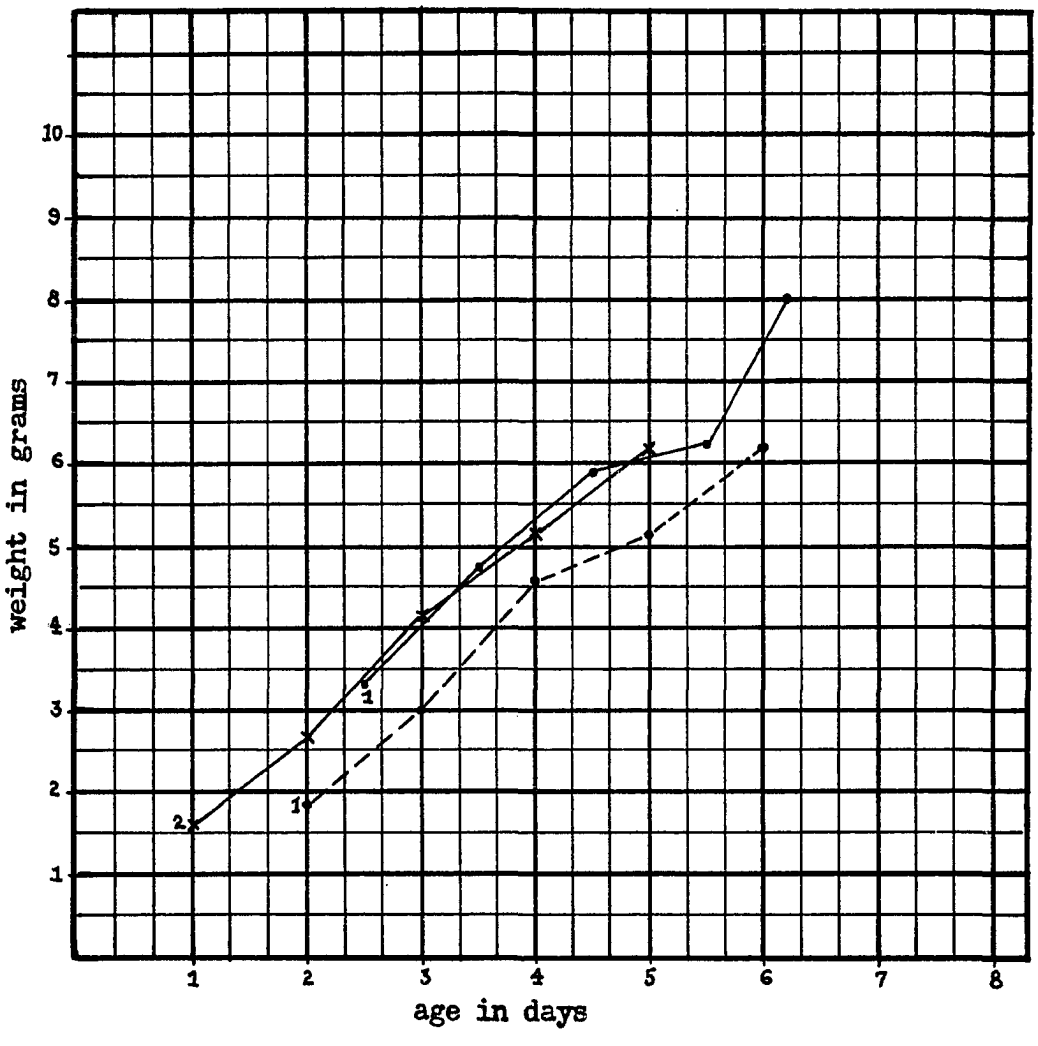


(2), (3), and (4) represent black-capped vireo chicks, 3 a Bell's vireo chick from nest B1. All were reared in black-capped vireo nest N35. (2) and (3) hatched June 26, (4) hatched June 27, and 3 hatched June 28.

3 fell out of nest and died on fourth day.

GRAPH IV

DAILY WEIGHTS OF MIXED BROOD IN
BELL'S VIREO NEST



(1) and (2) represent Bell's vireo chicks, 1 a black-capped vireo chick from nest N35. All were reared in Bell's vireo nest B1. (1) hatched early June 25, (2) on June 26, and 1 late June 25.

of their light color. On the fourth day the primary buds extend about 1/4 inch, 1/2 inch on the fifth day, and about 3/4 inch on the seventh day. On the eighth day, the feathers unsheath, except for those of the crown. These unsheath on the ninth day. By the tenth day, the young are fairly well feathered, and the primaries are about half unsheathed. On the eleventh day the primaries are about 3/4 unsheathed, and there may still be a few blood quills at the base of the bill.

The young keep their eyes closed most of the time until they are five days old. They grasp the bottom of the nest with their feet and are difficult to dislodge when only a few days old. On the sixth day they show fear when handled, and are able to sit on a perch. If unduly disturbed they may leave the nest as early as the tenth day. Usually they leave the nest on the 11th or 12th day. Normal departure occurred in two nests on the 10th day, in four on the 11th day, in three on the 12th day, and in one on the 13th day. In the last case, the sole juvenile in the nest was retarded in its development, feathering out on the 12th day.

Nest-leaving is staggered. Quite often it begins at sundown. One fledgling hops out of the nest and sits on the branch beside the nest for the night. The following dawn, the remainder leave the nest. The fledglings stay near the nest for a few days. Often they seek shelter in cedars where, were it not for their calls, they would be nearly impossible to locate. They call almost constantly for the first day or

so, thus maintaining contact with the adults.

As the young become more adept at flying, the family moves about its territory. In the Cogar study area, families moved from the nest-slopes down into the shaded ravine where there was water. I also saw some Texas families move from the hillsides down into more heavily wooded, though dry, stream beds. Generally the family remains on or near its territory until migration, though it sometimes wanders into neighboring territories or even farther. This is probably because the juveniles are not aware of territory and the adults follow them.

I watched one fledgling for 44 days after it had left the nest. At noon on the day it left the nest, I found it sitting seven feet up in a cedar about 70 feet from the nest. On the second day it was sitting about 12 feet up in an oak some 120 feet from the nest, having moved about 50 feet. It could fly, and we caught it only with some effort. When released, it flew 60 feet. Its landings were sometimes awkward.

For the next 25 days, I was able to find the male and the juvenile within 100 yards of the nest. I did not see the female in attendance after the fourth day (June 16). On June 21, I found her with a neighboring male working on a half-finished nest. She had left her first mate who was caring for their single fledgling. On the 43rd day after the young bird had left the nest, the male parent was observed to fly at his offspring in a hostile manner, trying to discourage

it from following him and from begging. He even appeared to be trying to escape from it.

The following morning, I found the young bird alone. It was following a small flock of chickadees and gnatcatchers about on the territory. It scolded with a high-pitched "shrade," as it had been doing since five days after it left the nest. Then it sang a squeaky song that reminded me somewhat of that of the rusty blackbird (Euphagus carolinus). I heard the parent male singing in another part of the territory a little later in the morning. He no longer scolded me as he had when attending the juvenile. So at 44 days after fledging, this one young bird was apparently completely independent of its parents.

I watched the development and postjuvenal molt in a bird that I made captive on the day it left the nest. It took two days for the captive to adjust to captivity, after which it flew toward me begging whenever I entered the room in which it was kept. For the first few days it called "shrief" every few minutes. Later it called infrequently, presumably only when hungry. At roosting time it gave a "chirruup" note, which it also gave upon awaking, but at no other time. It gave small "kek" notes when a dog entered the room. When it was 24 days old, it gave the typical "shrade" scold note of the adult for the first time.

At 12 days it could preen efficiently. At 15 days it could fly well. On its 17th day it attempted to take food

from the forceps with which I fed it instead of merely opening its mouth. Two days later it made its first attempts to find food for itself. It begged "at," then picked up, a larva placed beside it. It made bathing motions for the first time at the age of 24 days. When it was 28 days old, it caught insects and held them with its feet while pecking them apart. It was not very efficient at catching prey, being too slow. At this age it snapped its bill and attempted to bite when handled. At roosting time it flew to me, perching on my head. From the age of 10 days (nest-leaving), it slept in the typical adult position.

The weight of the captive increased gradually from 7 to 9.7 grams, its weight on its 22nd day. The legs had become noticeably blue by its 19th day. The rectrices grew from about 3 mm. at nest-leaving (10 days old) to 28 mm. at 24 days age. When the bird was 32 days old, the sheath-free rectrices were 38 mm. in length.

I noticed the first signs of the postjuvenal molt—two or three greenish feathers in the mid-dorsum—when the bird was 24 days old. At 28 days, the auriculars were molting. At 30 days the molt showed on the nape and occiput, the incoming feathers being darker and about a third longer than those of the juvenal plumage. The greenish first winter plumage formed a V across the back. Bright yellow axillars began to appear. The following day the tips of a few buffy feathers appeared on the breast. At 32 days of age, the lores

and eye ring were molting, and the lower half of the back was in first winter plumage.

When the bird was 37 days old, buffy first winter feathers formed an inverted V from the mid-line down the lateral tracts of the breast to the level of the second wingbar. The underlining of the wing had been replaced. The chin was molting. New feathers were coming in on the thighs. The head molt had proceeded from the forehead backward to the level of the eye. The dorsal plumage was about two-thirds replaced, the upper portion still being juvenal. At about this time the molt, which had been progressing rapidly, slowed, probably because of unfavorable environmental conditions. When the bird died accidentally at the age of 50 days, it was found to have been a female.

Care of the Young

Within a few hours after hatching, the male begins to bring food for the chick(s). Since he shares incubation, there is no question as to how he becomes informed of the event. It appears that as soon as a chick can rear its head and beg, this action serves as a releaser for the parent birds to begin feeding it. As soon as the male begins feeding, he ceases incubating and brooding. Actually, what little brooding he does is probably carried over from incubation before he changes his routine, for I have never seen any of the males in the nest after all the eggs have hatched,

although they did spend time standing on the nest rim or beside it, guarding and shading the young.

The chicks are brooded by the female during the cooler portions of the day, and at night until they are seven days old. During the warmer part of the day, she may sit high upon the nest or stand on the rim. As the chicks grow, the adults spend less time at the nest and more time getting food. At nest N14 the male spent 327 minutes of his 868 minute day (he was first heard at 5:20 a.m. and last seen at 7:48 p.m.), or approximately 37.6% of his time, standing beside, guarding, or shading the young on the first day after hatching. His longest guarding period was 55 minutes, the shortest two, the average 14. The female spent a total of 179 minutes brooding during the day and was on the nest at night (7:10 p.m. to 5:10 a.m.). Her longest daytime brooding period was 62 minutes (6:51 to 7:53 a.m.). After 10:00 a.m., she did not brood again until night. Besides brooding, she spent 160 minutes guarding (longest period 55 minutes; shortest one minute; average 16 minutes). The longest period that the male was absent from the nest was 47 minutes (6:34 to 7:21 p.m.). The female was absent once for 83 minutes (4:38 to 6:00 p.m.). The male spent 118 minutes guarding, the female, 138. The longest guarding period of the male was 39 minutes, of the female 30.

If the female is at the nest, the male gives the food he brings to her to feed to the young; if she is away, he

feeds them. Males provided roughly three-fourths of the food for the young. On the day of hatching of the last chick at one nest, the male made 77 (79.3%) trips to the nest with food and the female, 20 (20.6%) trips. Feeding was ineffective 4.1% of the time, for although food was brought 97 times, feeding was accomplished only 93 times. Twice the female ate the food, once she dropped and lost it, and once the male ate it. The male fed the young himself 40 (51.9%) times, and gave food for them to the female 37 times.

On the eighth day at this same nest, the male brought 73.0% of the provender, the female 26.9%. On the tenth day, he brought food 64 (68.8%) times, while the female brought it 29 (31.1%) times. On the latter day he gave the food to the female only twelve (18.7%) times. Once she begged for food he had brought but he ignored her and fed a nestling while she stood by. No feedings were ineffective on the eighth or tenth days.

At nest N13, which held a cowbird chick, the male brought 75% of the food on the second day, 70.4% on the fourth day, and 65.3% on the fifth day. On the second day he gave the food to the female 36.6% of the time. On the other days he did not give her any. Presumably because this pair had difficulty in satisfying the demands of the cowbird chick, the female was seldom at the nest when the male arrived with food. It seems that as the female spends less time brooding, she spends more time getting food for the chicks. Brooding

ceased on the fifth day at nest N13 (the female was not on the nest the fourth night).

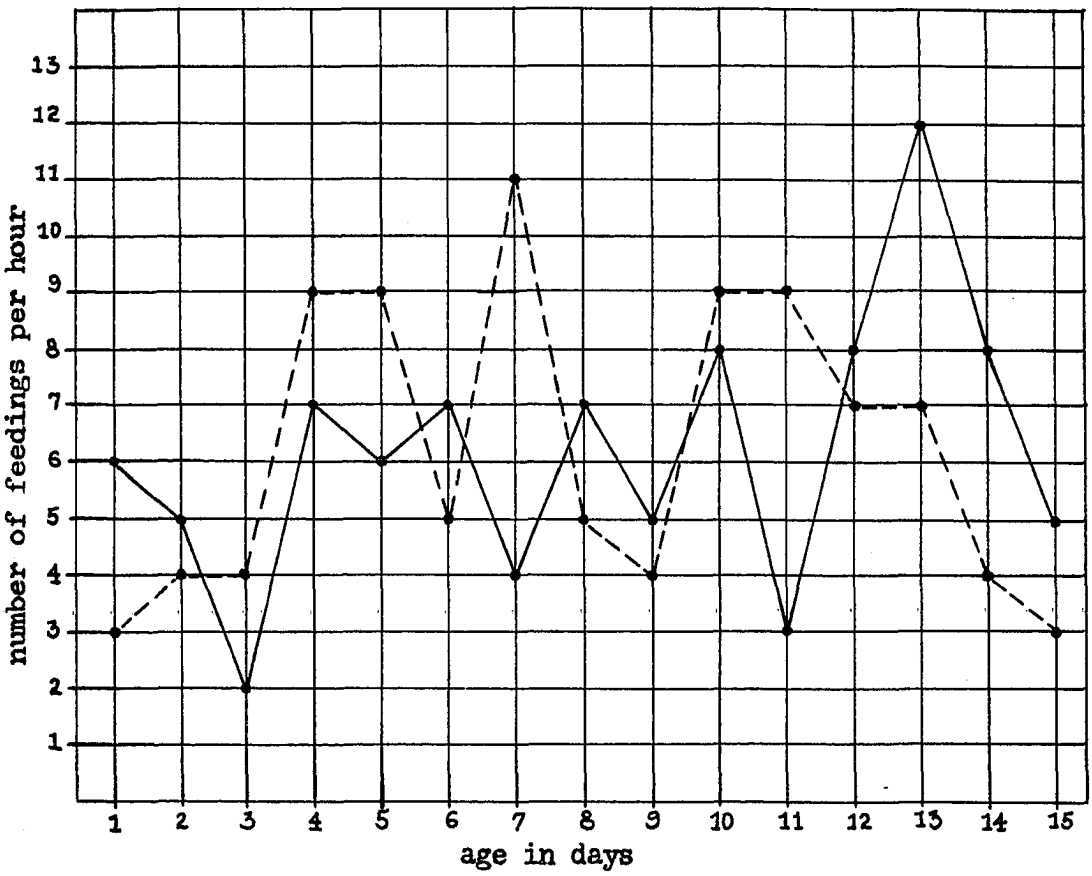
In feeding, the food is crushed in the mandibles, and arranged parallel to the bill before it is fed. Usually only one item at a time is brought; however, I did observe one male that brought several small items at a time several times on the first day. The female accepts food from the male with her mandibles wide open, peculiarly so, as if this action were a releaser to induce the male to turn the food over to her. Nice (1929) describes this action in Bell's vireos. In fact, the behavior of the two species at the nest is very much alike.

Wheelock (1905) mentions regurgitative feeding in vireos. This I have never seen in the black-capped vireo. If it occurs at all, it must be unusual. Lawrence (1953) and Stephens (1918) did not witness it in the red-eyed vireo (Vireo olivaceus). Nice (1929) once saw a female Bell's vireo swallow food, then pass it to the young four minutes later.

There appeared to be no set rhythm in feeding the young. Some birds fed steadily, others did not. Generally there is a peak in feeding of chicks in early morning and late afternoon, probably a counter-balancing of the effects of night metabolism without food. Before the early and after the late peak the adults must feed themselves for the night. Graph V depicts the feeding of four young at nest N14 on their first and tenth days. The number of feedings on both

GRAPH V

FEEDING RATES IN A NEST WITH FOUR
BLACK-CAPPED VIREO CHICKS



The number 1 (time) stands for the first hour of observation, 5:00 to 6:00 a.m.; number 2 stands for the hour 6:00 to 7:00 a.m., etc. The solid line shows feeding rates on the first day (chicks— -12 to 24+ hours old); the dotted line shows them (same brood) on the tenth day. The peak of feeding activity on the first day came between 5:00 and 6:00 p.m. On the tenth day, it occurred between 11:00 and 12:00 noon.

days was the same (93), but much larger items were brought to the young on the tenth day. Data from three nests which held two, three, and four chicks respectively, and covered different ages of these chicks from less than 12 hours to 9 days, revealed that the average number of feedings per chick per hour varied from 0.8 to 2.6. That is, at the peak of feeding during the day, a chick may receive three feedings per hour, and at the low point it may receive less than one feeding per hour. The most rapid feeding rate I observed was at nest N13 containing a cowbird chick, which was being fed at an average rate of 10.1 feedings per hour on its fourth day, and of 13 feedings per hour on its fifth day. At the end of the fifth day the chick weighed 18.40 grams, just a little less than four vireo chicks of the same age would have weighed. If this feeding rate is divided by four, then it compares with the rate per vireo chick per hour in other nests.

During the nestling period the male and female continue to announce their arrival at the nest as they do during incubation. The male nearly always sings a phrase or two of the nest song as he comes to the nest, and the female scolds softly as she arrives and leaves. At first the young respond only to vibration of the nest, but as they grow older, they respond to the signals of the approaching adults. It was hard to ascertain that the chicks responded, but I could see their heads above the nest rim at seven to eight days and they responded at that age. A cowbird chick responded to the

sounds of the adult vireos at an age of 5 days.

A vireo, caring for her second brood unaided by the male, was very quiet on the second day after the young hatched, although she scolded softly sometimes as she left or arrived, as she had when incubating. On the sixth day, however, she gave rather squeaky imitations of the male nest song as she arrived. This suggested to me that announcing arrival at the nest is more than a signal between the adults. It appears to be a means of keeping the family together after fledging, and this female seemed to be preparing to assume this task.

After each feeding, the adult bird looks for fecal sacs which appear to be normally discharged only at this time. The nest is kept clean until the chicks leave, at which time the last few droppings may remain about or in the nest. The fecal sacs are usually carried more than 15 feet from the nest before they are dropped. The sacs are eaten by the adults during the first five days of the chicks' lives; from the fifth day on they are carried away. A pair caring for a cowbird chick began carrying away sacs on the second day, but ate about half of them. On the third day they carried it all away. Perhaps the size of the fecal sacs determines when the adults no longer eat them. At a nest of four small chicks, excreta are removed about once an hour (average rate for entire day), and about a third again as often when they are older. Male and female shared this duty evenly on the first

day at nest N14. On the eighth and tenth days the male carried away two fecal sacs for every one removed by the female.

The nests are kept clean not only of excreta and eggshells but also of other debris. This includes dead chicks, if these are small enough for the adults to lift. The disappearance of small vireos in nests with cowbird chicks puzzled me until I observed one nest continuously from the hatching until the chicks were gone. Cowbird eggs are usually deposited in the nest before the vireo clutch is completed. The cowbird egg hatches two to four days before the vireo eggs (12 day incubation period for the cowbird in black-capped vireo nests) and by the time the young vireos hatch, the cowbird outweighs each of them more than ten times. In one nest, a three-day-old cowbird weighed 11.31 grams while its nest mate, a newly hatched vireo, weighed 0.86 grams (see Figure 1). The cowbird is able to raise its head up far above the vireo in begging, and gets most of the food. The cowbird requires about as much food as four vireo chicks so it is hungry and begs most of the time. The vireo chick gets scarcely any food, and is trampled and crushed by its parasitic nestmate. After a day or two, the vireo chick dies and its body is removed.

I watched a female vireo remove the bodies of two two-day-old chicks one morning. They had died because of the presence of a cowbird chick. She brought food to the cowbird, then, after feeding it, she began working in the nest. After

four minutes she lifted the body of one dead chick out and flew away with it in her bill. She came back, fed the cowbird, and removed the other dead chick. These chicks must have weighed between one and two grams, so she carried between one tenth and one fifth of her own weight.

Stephens (1918) placed certain foreign objects in the nest of a red-eyed vireo and found that the birds removed them. I did not experiment with the black-capped vireo. An incubating female deserted a much-incubated clutch of eggs because a leaf fell in the nest and covered the eggs. In another nest, a young bird died on its ninth day. It was evidently too large to be removed by the adult. The other chicks in the nest fledged as I inspected the dead nestling. It is well that they did, for in a short while the nest was over-run by ants.

The young are actively defended by the adults who threaten, pounce, and snap their bills at intruders. They also warn the young of danger. I have never observed injury feigning. In general they ignore other species of birds, but I have seen female vireos intimidate female cowbirds by assuming a crouching position and opening the mandibles wide. I once saw a female vireo behave this way toward a field sparrow (Spizella pusilla) that happened to startle her on the nest. All adults scolded every time they saw me near their nests, but they were particularly excited about nest-leaving time.

Two males of double-brooded pairs brought first broods to the vicinity of the nest while the female was incubating the second clutch and caring for the second brood, but I never saw the male or juvenile birds go to the nest. There was no evidence of nest helpers. If the female does not remate for the second brood, she assumes complete responsibility for it up to the time of fledging.

Nesting Success and Losses

Much of the black-capped vireo's reproductive effort is unsuccessful. From 243 eggs of which I kept record, only 43 chicks that lived to the age of fledging were produced. In other words, 17.6% of the eggs were successful to this degree. Kendeigh (1942) gives data on nesting success for nine species of birds building elevated, cupped nests, and the percentage of eggs that produced fledged young ran from 29 (wood thrush, Hylocichla mustelina) to 58 (cardinal, Richmondena cardinalis). The average percentage of eggs of 16 species (including cavity-nesting birds such as the house wren (Troglodytes aedon) that produced fledged young was 42.7. Putnam (1949) found that of 245 eggs of the cedar waxwing (Bombycilla cedrorum), 69.8% produced fledglings. Nice (1937) considered a 23% success of the song sparrow (Melospiza melodia) as very low. She considered the 40 to 46 per cent success reported in eleven studies by various investigators as the usual rate for open nests of passerines in the North

Temperate Zone.

I have found only a few nesting success figures for other species of vireos. Lawrence (1953) reported that of 98 eggs in 30 nests of the red-eyed vireo, 59 produced fledged young, a success of 60%. Ely (1957) found that only one of 14 Bell's vireo nests produced young (9.1% of the eggs produced fledglings). Pitelka and Koestner (1942) reported that of 26 nests of the Bell's vireo, five were successful, a success of 19%. Counting any nest successful if it produces one vireo fledgling, of 76 black-capped vireo nests 15 were successful, a nest success of 19.7%, a figure comparable to that of the last-named study.

Tables V, VI and VII give data concerning the causes of nest loss. Loss of eggs before hatching amounted to 55.1% of all eggs laid. Of this loss (134 eggs in all), I attribute 72.3% (97 eggs) to cowbird activity. This includes beak-gouged eggs found under and in nests, eggs which disappeared one at a time with subsequent laying of cowbird eggs, and eggs deserted because of cowbirds. Pitelka and Koestner (1942) estimate that 17 of 26 Bell's vireo nests were unsuccessful because of cowbirds (four nests failed for other reasons). Ely (1957) found that 10 of 13 Bell's vireo nests were parasitized, and that only one parasitized nest was successful (the cowbird egg in this nest did not hatch). David F. Parmelee ascertained that 12 of 22 Bell's vireo nests at Norman, Oklahoma, in 1954, were parasitized. My own

TABLE V

ANALYSIS OF NESTING SUCCESS FOR THREE YEARS

Year	1954	1955	1956	1956	Totals
Locality	Okla.	Okla.	Texas	Okla.	
Nests started	29	25	29		83
Nests laid in	26	25	25		76
Eggs laid	85	83	75		243
Eggs lost (See Tables VI and VII)	24	20	35		79
Eggs deserted	24	21	10		55
Eggs fully incubated	37	42	30		109
Eggs infertile or addled	6	6	2		14
Eggs hatched	31	36	28		95
Chicks lost at hatching	8		1		9
Chicks lost to predators	2	11	3		16
Chicks lost because of presence of cowbird chick	8	1	16		25
Chicks that died in nest	2				2
Chicks fledged	11	24	8		43
Nests successful in fledging young	5	7	3		15
Pairs successful in rearing at least one chick	6	17	6	17	46
Number of pairs observed	16	21	19	21	77

TABLE VI

ANALYSIS OF EGG LOSS

	Number	Percentage
Egg loss before hatching	134	55.1 of eggs laid
Egg loss due to cowbirds	97	72.3 of those lost
Eggs destroyed	67	
Eggs deserted	30	
Human interference	18	13.4 of those lost
Predation by mammals	2	1.4 of those lost
Predation (snake)	10	7.4 of those lost
Desertion	7	5.2 of those lost

TABLE VII

ANALYSIS OF LOSS OF INCUBATED EGGS AND NESTLINGS

	Number	Percentage
Eggs fully incubated	109	44.8 of eggs laid
Infertile and addled eggs	14	
Chicks that died in hatching	9	22.9 of fully incubated eggs
Chicks died	2	
Chicks lost to predators	16	19.0 of viable chicks
Chicks died because of presence of cowbird chick	25	29.7 of viable chicks

observations of Bell's vireo in Caddo County, Oklahoma, also indicate great losses of eggs and young because of cowbirds.

Eighteen black-capped vireo eggs (13.4%) of those lost, were deserted because of my activities. I learned to be more discreet after the first season, and the loss was reduced from 10 eggs (three clutches) the first season to one egg (an incompleted clutch) in 1956. I do not believe that my activities caused any more losses to predators than there would have been had I not been present. I probably frightened away as many predators approaching nests as I led to nests. And in no nest near a blind erected for daily observation was there any loss as long as the blind was present.

Two eggs were lost to a fox squirrel (Sciurus niger), the only case of mammalian predation which I observed. Ten eggs were lost to other predators, very likely snakes. Entire clutches disappeared without a trace of disturbance about the nest, and this would suggest predation by snakes. Snakes were numerous in the area, and I caught a pilot blacksnake (Elaphe obsoleta) in the act of swallowing a nestful of young vireos. One clutch of four was deserted when a leaf fell into the nest (see p. 54). Three eggs that were deserted were the fourth clutch of a pair of vireos that had already deserted three clutches as a result of cowbird parasitism.

Eighty-four viable chicks were produced from 109 fully incubated eggs. Infertile and addled eggs and chicks

which died at hatching totalled 23. Added to this reduced-reproductive-vigor-loss were two chicks which died unaccountably as nestlings. One chick died at the age of nine days, the other on its third day. Most losses occurred at the beginning and at the end of the breeding season, indicating that loss of reproductive vigor probably lies in reduced "breeding drive or incentive" and decline of optimum weather. Kendeigh (1942) has shown that the percentage of success in the house wren correlates with the mean temperature of the period in which the eggs are laid.

Reduced-breeding-drive is also reflected in the number of nests abandoned before completion. Four of six nests represented first nesting attempts, one was a late attempt, and one a second nesting. One other early nest was completed, but I found no evidence that eggs were deposited in it. It is possible that the eggs were removed by cowbirds before I visited it.

During the nestling period, as during laying, the chief loss was due to cowbird parasitism. In all cases in which a cowbird chick occupied the nest, no vireo chicks survived. Nestling predation was, in nearly every case, I believe, by snakes. In 1956, in Oklahoma, three seven-day-old chicks in one nest were eaten alive by ants (Crematogaster sp.).

Toward the end of each breeding season, I surveyed the study areas and adjacent areas, and observed whether or

not the adults were in attendance on juveniles. Since most early nestings were unsuccessful, few juvenile birds were independent of the adults by late July and early August. This survey served as another check on how successful the birds had been in rearing young. Of a total of 77 pairs surveyed, 45 (59.7%) were successful in fledging at least one young bird by the end of the breeding season (see foot of Table V).

Fall Migration

The young birds disappear from the breeding grounds first. They are followed by the adult females, then by the adult males, some of which remain longer than others. Fall departure appears to be less precipitous than spring arrival. The species has been recorded in Nayarit, Mexico, as early as August 27. A specimen (MC:OC) taken on that date was a female. My latest central Texas date for a female in 1955 was August 28 (one bird, Kerrville). This must have been about the date of departure for the females of that area that year, for I looked for one every day for a month thereafter, but saw none. The last female seen at San Angelo, Texas, in 1884 was seen September 6 (Cooke, 1888). The last female seen in my Oklahoma study area in 1954 was seen September 9 (one bird).

As for males, my latest central Texas date for 1955 was September 11 (three seen, Hays County). The last male seen at San Angelo, Texas, in 1884 was seen September 25

(Cooke, 1888). The last male seen in my Oklahoma study area in 1954 was seen September 17 (one bird).

Survival

In 1954, I banded 24 breeding adults (12 pairs) in the Oklahoma study area. In 1955 I found nine of the banded males (75%) and five of the banded females (41.6%) in the same area. One female banded in 1954 I did not see in 1955 but did find in 1956. So 15 (62.5%) of 24 birds are known to have survived for one year.

In 1955 I banded five adult males and nine adult females. Of these, four males and three females returned in 1956, an 80% return for males, 33.3% for females, 50% for both sexes.

In 1956, nine males and five females, 14 (50%) of the 28 birds known to be in the area at the end of the 1955 season, returned.

Birds returning for a third season (1956) included five males and two females, seven (29.1%) of the 24 birds banded in 1954. Thus from data obtained during three years of observation, 41.6% of the males and 16.6% of the females were three years old or older; 33.3% (males) and 25% (females), two years old or older; and 25% (males) and 58.3% (females), one year old or older birds that had just entered the area. Theoretically, if the percentage survival of a species breeding at one year of age is 75, 25 percent of the

population will be made up of birds one year of age, 19 percent of birds two years old, and 56 percent of birds three years old or older, with one bird in a 100 living to be 13 years old.

Using Birkitt's formula in modified form (Hann, 1948) for calculating average age, that of a male Vireo atricapillus in the study area is estimated to be four to five years (survival rate, 75 to 80%), of a female, one-and-a-half to two years (survival rate, 33.3 to 41.6%).

I have not had any returns on banded fledglings, but this is not surprising for I banded only 30. Birds in their first breeding season probably have little chance to breed in the area in which they were reared because the older birds remain in, and defend, their own territories. Of 13 males and 10 females caught in 1956, only one pair were first year birds (8.6%).

The sex ratio for the Oklahoma study area in 1954 appeared to be 106 males to 100 females; in 1955, 100:100; and in the Texas study area in 1956, 131:100. Stewart and Aldrich (1951) found differences in sex ratio in vireos of other species were high. Nice (1937) observed that female "survival" was two thirds to three fourths that of males in the song sparrow and that the sex ratio was a little greater on the male side. The difference in returns for females (in this study 55.5% (1955) and 41.6% (1956) of those for males) may be explained by their elusiveness and lack of attachment

to their territories.

CHAPTER IV

HABITS

The habits of this vireo are much like those of other vireos, especially the white-eyed and Bell's vireos. The black-capped vireo appears to be the most active of all vireos. Although not especially shy, it is difficult to see and to keep in view. The female, which is especially difficult to follow, is seldom seen except near the nest or young. When excited, the males often flick their wings open and shut quickly. When alarmed, adults snap their bills as well as scold. Sutton (Peterson, 1947) mentions the habit of hanging head downward for an instant before "diving" to a lower branch. The species is not as responsive to "squeaking" as are many other birds. It bathes whenever water is available. Sun-bathing and dust-bathing were not observed.

From what I have observed, I believe that adult black-capped vireos roost solitarily. When there are fledglings, the family may roost in the same tree. They generally roost near the top of the tree and the only trees I have seen them go into were cedars. However, I have made few

observations at dusk and they probably also roost elsewhere. Roosts appear to vary from night to night but are in the same general area, and are usually not far from the nests. Brooding or incubating females spend the night on the nests, sleeping with the head turned back over the shoulder and the bill tucked under the tertials. My captive bird slept in this manner also.

The male black-capped vireo sings at all seasons; however, the greatest amount of singing occurs in the early part of the breeding season. I have heard males singing in December on the wintering grounds, though it was only a burst or two in the morning and usually occurred when two males met each other. According to such observations as I could make, I do not believe that males have established territories in winter, but rather that the sight of another male stimulates singing.

The song has been likened to that of the following birds: white-eyed vireo, Bell's vireo, wood thrush (Hylocichla mustelina), mockingbird (Mimus polyglottos), towhee (Pipilo erythophthalmus), and yellow-breasted chat (Icteria virens). I thought it resembled that of the blue-gray gnatcatcher (Polioptila caerulea). It seems to be more varied than that of any other vireo in the United States. It is quite long, includes some definite mimicking, and yet it is peculiar to the species. Nice (1931) gives a detailed account of the song and its phrasing. I counted the songs (a song being a

complete set of phrases) of a male in May in Hays County, Texas, and found that he gave 82 in five minutes. This was at the height of his singing.

Each bird has its own phrases, and individuals can be distinguished from song alone. There are at least four different types of songs. The "announcement" song, given on arrival, announces the presence of the singer to other birds. This is the song usually described. The "courtship" song is given when the male is courting the female. It is a rapid series of the phrases used in the announcement song, run softly together in a low, bubbling torrent. The "nesting" song is a short phrase or two given when the male goes to the nest or approaches the fledglings with food. The "territorial" song is given when two males are disputing possessions. It is very similar to the courtship song. I have heard the white-eyed vireo also give such "courtship" songs.

When singing the announcement song, the male sits upright on one of the highest perches in his territory. When singing the courtship song, however, he is often on a fairly low perch, near the female which he is following about. I have heard a female give nesting songs when she came to feed nestlings she was rearing by herself. I have never heard any other "song" from females. Young males begin singing in late summer, and since they resemble females in plumage, this may have led to the statement that the female sings (Lloyd, 1887). The male never sings on the nest as the warbling vireo does

(see page 30).

The black-capped vireo is not an early riser. I heard songs of the black and white warbler (Mniotilta varia), field sparrow (Spizella pusilla), cardinal (Richmondena cardinalis), yellow-billed cuckoo (Coccyzus americanus), painted bunting (Passerina ciris), and Bewick's wren (Thryomanes bewicki) before I heard the black-capped vireo. In June in Oklahoma, the black-capped vireo is first heard at about 4:55-5:10 a.m.

Other sounds made by the adults are scolding and worry or protest notes. The typical scold note is a single, harsh, low "shraade," which sounds something like the scold note of the Bewick's wren. The scold note of the male is slightly higher in pitch than that of the female, and that of the young bird is still higher. A double note, "shad-dit," is given when the birds are especially excited. A worry or protest note, a small, squeaking "tinct," "tsk," or "kek," is given when the birds are only slightly disturbed. The scold note given by one male to another is different from that given when the species is scolding some other animal. The young make begging noises, and have a distinctive call note, "shrief," given to inform the parent birds of their whereabouts. A note given by the young Bell's vireo is similar, but slightly lower in pitch. A fledgling black-capped vireo reared from the egg by Bell's vireos in an area well removed from black-capped vireos, gave calls and scold notes typical

of *Vireo atricapillus*. I never heard it sing.

My captive young bird gave a distinctive "chirrup" when going to roost and upon awakening, but at no other time.

CHAPTER V

FOOD AND FEEDING

The black-capped vireo, an arboreal species, rarely leaves the trees and shrubs of its domain. It feeds mainly in the upper strata of this vegetation, gleaning insects that live on trees, especially oaks. I have never seen it feed on the ground. The bulk of its food is larvae, and most of these are Lepidoptera. I have seen it eating small butterflies (Pieridae) and once, a large dragon-fly (Odonata, Aeschnidae). The young, when small, are fed mainly small larvae, sometimes spiders, and small flies. As they grow, the items fed to them are larger; bigger larvae and such items as small grasshoppers and katydids are brought. As much as a third of their food may consist of orthopterans.

Tables VIII and IX present an analysis of stomach contents from eleven black-capped vireos. All these specimens were collected between the hours of eight and ten in the morning. Two were taken in the northern part of the breeding range (Oklahoma), three in the central (Texas), three in the southern (Coahuila, Mexico), and three on the wintering

TABLE VIII

ANALYSIS OF STOMACH CONTENTS

Kind of Food	Stomach Number										
	1	2	3	4	5	6	7	8	9	10	11
Animal Matter:											
Arachnida											
Araneida			1		1	3+					1
Chilopoda							1				
Insecta											
Unidentified order					1						
Orthoptera (1) *											
Tettigoniidae	1										
Locustidae				1							
Neuroptera (2)								1			
Odonata (3)											
Anisoptera		1									
Zygoptera		1									
Hemiptera (4)											
Unidentified family					1				1		
Phymatidae										1	
Pentatomidae			1								
Homoptera (5)											
Unidentified family									2		
Cicadellidae										2	1
Fulgoridae				1						1	
Coleoptera (6)											
Unidentified family										1	2
Buprestidae						1					
Cleridae											1
Phalacridae						1					
Coccinellidae					1						
Coccinella						1?					1
Chrysomelidae	1	1								1	1
Pachybrachys										1	1
Cryptocephalus	1?			1?							
Curculionidae								7	1		

TABLE VIII - Continued

Kind of Food	Stomach Number										
	1	2	3	4	5	6	7	8	9	10	11
Lepidoptera (7)											
Unidentified family											
adults	2	1		3				1	1	3	1
larvae		2	1	1					2		
Notodontidae (larvae)					2						
Hesperiidae (larvae)				1							
Phalaenidae (larvae)	1							1			
Pseudoletia							1				
Diptera (8)											
Unidentified family								2	1		
Vegetable Matter:											
Seeds											
Unidentified	2							1			
Leguminosae	1										
Compositae		16	20						2		

Stomach Number	Locality	Date
1	Caddo Co., Oklahoma	September 9, 1954
2	Nayarit, Mexico	December 28, 1955
3	Nayarit, Mexico	December 29, 1955
4	Coahuila, Mexico	June 17, 1956
5	Hays Co., Texas	July 9, 1956
6	Kinney Co., Texas	July 13, 1956
7	Uvalde Co., Texas	July 12, 1956
8	Caddo Co., Oklahoma	September 9, 1954
9	Sinaloa, Mexico	December 21, 1955
10	Coahuila, Mexico	June 18, 1956
11	Coahuila, Mexico	June 18, 1956

* Numbered for use in Table IX.

† Number of individuals found.

TABLE IX

FOOD OF BLACK-CAPPED VIREO

Stomach No.	Kind of Food Estimated Percentage of Bulk of Total Contents									
	Vegetable Matter	Animal Matter Invertebrates								
		Spiders	Centi-pedes	Insects Orders (see Table VIII)						
				1	2	3	4	5	6	7	8
1	5			25					20	50	
2	50					9			1	40	
3	60	5					5			30	
4				1				5	9	85	
5		5					5		5	85	
6		20							80		
7			50							50	
8	1				1				40	50	8
9	5						15		15	60	5
10							5	15	20	60	
11		5						5	50	40	

grounds (Sinaloa and Nayarit, Mexico). The sample is much too small to give a complete picture of the food habits, but it does suggest that this vireo is not unlike other vireos in its feeding habits. Bunker (1910) suggested that Vireo atricapillus had a very restricted diet. This does not appear to be the case. Most of the items found have been found in the stomachs of other vireos by Chapin (1925). Exceptions are the centipede, the tettigoniid, and the fulgorid.

Despite the considerable variety in the contents of these stomachs, there is a great deal of similarity in the food of specimens collected in the same localities. What the species eats is no doubt influenced by the locality, the season, and the time of day. The stomach contents of an immature male and an immature female taken at the same locality on two subsequent mornings were very similar.

It appears, as is true of other vireos, that the black-capped vireo eats some vegetable matter in the fall and winter. Over 50% of the bulk of the stomach contents of two immature birds taken in Mexico in December was seeds. The weather was cool and these birds may have resorted to vegetable food in the absence of numbers of insects. An adult taken in a warmer locality a few days earlier had only two small seeds in its stomach. No vegetable matter was found in the stomachs of the specimens taken in summer.

It is interesting to note that in no stomach did I find any sand or gravel. It is true that the bulk of the

food is soft in nature, and the birds do crush it quite thoroughly before eating it. The stomach is fairly muscular and the hard (sclerotized) parts of insects may serve as grinding material. My captive bird regularly cast up pellets composed of undigested hard parts of insects. Herrick (1901) mentions that vireos are known to regurgitate such pellets.

The black-capped vireo can live without having surface water available. Much of its food (insect larvae) has a high water content. The bird takes advantage of dew and rain when it occurs.

CHAPTER VI

ECTOPARASITES AND DISEASE

The black-capped vireo appears to be unusually free of ectoparasites. I have never found a bird or a nest that had mites, mallophaga, or parasitic diptera. This statement is the more valid in view of the fact that within the study area other birds and their nests had parasites of various sorts.

One adult male black-capped vireo disappeared from his breeding territory. This was the only adult bird under observation that may have died during the breeding season in the course of this study. Two nestlings died of unknown cause(s) in 1954.

Some birds had foot trouble as a result of my placing the color bands below the metal bands (done to make the birds individually recognizable in the field). One male had a wisp of plant fiber or spider web tightly bound about his ankle which was swollen as a result.

CHAPTER VII

TAXONOMY

In the course of this study I examined and measured 175 specimens of Vireo atricapillus from various collections in the United States (see Appendix II). I found no geographical variation in coloration. Northern specimens tended to be slightly larger than southern (see Table X). Arbitrarily I divided the specimens representing breeding birds into north, central, and southern groups according to political boundaries. This was a reasonable procedure because all Oklahoma populations are fairly well separated from those of Texas, and since most of the Texas specimens came from Kerrville, the Texas group was separated from the Mexican. It was not possible to compare specimens of females in a like manner because of insufficiency of material. There is insufficient geographical variation to warrant the naming of races.

In comparing size in different age categories (see Table XI), I find that the oldest males tend to be the largest birds in a population while the young (one year old or less) females tend to be the smallest. Young males (one year

TABLE X

GEOGRAPHIC VARIATION IN MEASUREMENTS OF ADULT* MALES

Wing (in millimeters)

Number measured	Geographic group	Extremes	Mean	S.E. (mean)	S.D.
18	Oklahoma	54-59	55.97	0.36	1.53
57	Texas	52-58	55.71	0.18	1.34
5	Mexico	53-57	54.80	0.67	1.50

Tail (in millimeters)

Number measured	Geographic group	Extremes	Mean	S.E. (mean)	S.D.
18	Oklahoma	41-46.5	43.89	0.39	1.63
57	Texas	39-46	43.47	0.21	1.61
5	Mexico	43-46.5	44.10	0.55	1.22

Culmen (in millimeters)
(from posterior edge of nostril to tip)

Number measured	Geographic group	Extremes	Mean	S.E. (mean)	S.D.
18	Oklahoma	7-9	7.83	0.43	1.81
55	Texas	7-10	7.82	0.08	0.59
5	Mexico	7-8	7.80	0.20	0.44

Tarsus (in millimeters)

Number measured	Geographic group	Extremes	Mean	S.E. (mean)	S.D.
13	Oklahoma	18-20	19.46	0.20	0.66
45	Texas	18-20	19.08	0.15	1.00
4	Mexico	19	19.	.00	.00

*Breeding birds two or more years old.

TABLE XI

VARIATION IN MEASUREMENTS OF DIFFERENT AGE GROUPS

Wing (in millimeters)

Number measured	Sex	Age in years	Extremes	Mean	S.E. (mean)	S.D.
85	♂	two plus	52-59	55.52	0.15	1.39
37	♂	one or less	50-56	54.26	0.21	1.27
7	♀	two plus	52-57	55.21	0.64	1.69
11	♀	one or less	52-57	52.82	0.45	1.48
35	♀	all ages	52-57	54.00	0.29	1.72

Tail (in millimeters)

Number measured	Sex	Age in years	Extremes	Mean	S.E. (mean)	S.D.
85	♂	two plus	39-46.5	43.75	0.17	1.56
37	♂	one or less	40-45	42.70	0.25	1.53
7	♀	two plus	40.5-44	42.64	0.48	1.29
11	♀	one or less	41-45	42.64	0.48	1.58
35	♀	all ages	40.5-45	42.61	0.21	1.22

Culmen (in millimeters)
(from posterior edge of nostril to tip)

Number measured	Sex	Age in years	Extremes	Mean	S.E. (mean)	S.D.
83	♂	two plus	7-10	7.81	0.21	1.93
36	♂	one or less	7-9	7.80	0.09	0.54
7	♀	two plus	7.5-8	7.78	0.20	0.53
10	♀	one or less	7.5-8	7.65	0.16	0.51
34	♀	all ages	7-10	7.38	0.08	0.51

Tarsus (in millimeters)

Number measured	Sex	Age in years	Extremes	Mean	S.E. (mean)	S.D.
67	♂	two plus	17-20	19.13	0.10	0.83
29	♂	one or less	17-22	18.93	0.23	1.23
6	♀	two plus	18-19	18.66	0.22	0.53
11	♀	one or less	18-19	18.50	0.17	0.55
34	♀	all ages	17-20	18.68	0.13	0.74

old or less) are likely to be larger than females of any age, and older females tend to be larger than younger ones.

Ridgway's (1904) description of the "adult" is actually of the adult male. His description of the "young" is of the first winter plumage. He fails to distinguish between the sexes, probably because he had few, if any, female specimens at hand when he prepared his description.

Characters of Plumage Useful in Determining the Sex and Age of Specimens

Early illustrations showed no difference between the sexes, most of these drawings being patterned after that by Werner in the Bulletin of the Nuttall Ornithological Club (Coues, 1879). A number of things about this painting suggest that the artist was either not closely observant or was working from poorly prepared specimens. The colors of the irides and tarsi are wrong. There is no interruption of the spectacle. The nest appears to be moss and lichen covered, which would be exceptional were it so. No mention is made of it by either Werner or Brewster (1879). The only really adequate illustration of the bird, as far as I am aware, is one by L. A. Fuertes (Cooke, 1909). Bunker (1910) published a photo which shows, in black-and-white, the difference in pattern between the sexes dorsally.

The head of the adult male is black except for the bold white spectacle, chin, and throat. In fresh plumage, the nape feathers may have gray tips. Darkness of the head

varies with age, as Bunker (1910) suspected. Heads of males one year old (age determined by examination of their primary coverts and flight feathers) usually are gray rather than black from the posterior edge of the eye backward over the occiput and nape; the blackness of the cheeks contrasts with the gray of the back of the head; and, if the plumage is fresh, the crown feathers are noticeably edged with gray. Males in first winter plumage are light gray on the forehead and crown. In females, darkness of the head apparently varies individually. Birds in first winter plumage have light gray on the forehead, crown, occiput, and nape. The spectacle interruption is dark gray, contrasting with the light gray of the crown. In older females the forehead and area about the spectacle may be dark gray, though I have seen a female which I knew to be at least three years old that had a light gray head.

The chin, throat, breast, and belly of all males, regardless of age, are white. Those of females are washed with buff—the younger the individual the stronger the buff. Adult males are strongly yellow on the sides and flanks; in first year birds the yellow of these areas is washed with gray.

In the 175 specimens I have handled males and females are readily distinguishable by careful examination; only a few would cause difficulty in the field. Some females are dark enough on the forehead and cheek to look like males in

faded first breeding plumage.

Two specimens, a female from Guerrero (MVZ 112769), and a male (?) from Morelos (MMNH 10983), are somewhat atypical. In most respects these specimens are like Vireo atricapillus, but they differ in that the crown, nape, and back all are gray. The wingbars of the male are white instead of yellow, and the dark parts of the head are gray instead of black. This specimen resembles a female black-capped vireo more than anything else, but is slightly grayer on the back. Both are from the southwestern edge of the black-capped vireo's winter range, and from the eastern slope of the Sierra. They may represent a new form, or may be hybrids (Vireo atricapillus x Vireo huttoni). I have included them as records under this species, but have omitted their measurements.

Description of Juvenal Plumage

This fluffy, rather lax plumage, which has not heretofore been described, is, generally speaking, gray above and white below. The back and scapulars are lead gray, of a shade a trifle darker than that of the top of the head, back of the neck, rump, and upper tail coverts. The lores are white, the spectacle white, interrupted antero-dorsally by gray. Below the auriculars the white is strong enough to form a sort of streak. The flight feathers are blackish gray, edged (especially on the secondaries) with lemon yellow. The tertials are broadly edged with yellow, as are the middle and

greater secondary coverts, whose pale yellow tips form two distinct bars. The alulae and primary coverts are gray, the wing-linings white. The underparts throughout are white, except for the flanks, which are tinged with yellow.

In a living female 22 days old the mouth-lining was pink; the gape pale yellow; the maxilla dark grayish horn; the mandible pink, darker at the tip; the feet blue, tinged with pink; the irides dark brown. Other juveniles which I have handled were similar. So far as I have been able to ascertain juvenal males do not differ from juvenal females.

The eye color changes during the first winter to the reddish brown of breeding birds. Birds with unossified skulls collected in December still had dark brown irides. Adults taken at the same time had red-brown eye color. Breeding birds all have the typical eye coloration. This change also occurs within a year in the red-eyed vireo (Dwight, 1900).

The color of the tarsi changes from pink to grayish blue shortly after the young leave the nest. I have seen one young bird whose tarsi were blue before it left the nest. I think that birds whose legs change color early in this way are males, but specimens must be collected to prove this point.

The Molt

There is no natal down. The juvenal plumage is lost

by an incomplete postjuvenal molt. The juvenal primary wing coverts, remiges, and rectrices are retained until the first postnuptial molt. Other vireos that I have examined, which include the warbling, Philadelphia (V. philadelphicus), Bell's, yellow-throated (V. flavifrons), and white-eyed show retention of the primary coverts so that this appears to be a character of the genus. Dwight (1900) indicates only that the remiges and rectrices are retained in the vireos in New York, except for the white-eyed vireo in which he thought they were. I found specimens of Vireo griseus in which this was not the case however, and so, in some instances at least, the species is not different in this respect from other vireos. There may be geographic variation in the extent of the postjuvenal molt in vireos.

There is a partial, early winter (prenuptial) molt of head feathers in the male black-capped vireo. I do not know if it occurs in the female as well. I had wondered why I never saw any gray-headed males (young males are gray-headed after the postjuvenal molt) in the spring. Examination of November specimens showed a molt in progress on the head of males, both adult and birds of the year (aged on the basis of skull ossification). Furthermore, I captured a male at the nest which had very worn primary coverts early in the breeding season, yet its head was black, not gray. It was a first-year male judging from plumage characters. It will be interesting to learn whether such a molt occurs in any other vireo.

The black-capped vireo is the only vireo showing marked sexual dimorphism and this special molt may have arisen (or been retained) in conjunction with this character. In other words, black-headed males may be better able to obtain mates than gray-headed (female-like in appearance) ones, so the molt to insure breeding of first-year birds.

The postnuptial molt, which is complete, begins in early July in Texas, and in middle and late July in Oklahoma. It starts in the anterior parts of the body, and after it is underway the molt of the primaries and secondaries begins, proceeding from the first to the tenth. When most of the primaries have been replaced, the rectrices are lost, usually all at once with the result that in August there are many bob-tailed birds. Being without a tail does not appear to handicap the birds in any way. I once accidentally pulled the rectrices out when catching a female. She continued incubation and reared a brood in her bob-tailed condition. The progress of the postjuvenal molt is described in the section on development of the young (see page 45).

CHAPTER VIII

DISTRIBUTION

The black-capped vireo is limited in its breeding to the south central United States and north central Mexico. It occupies an area in which eastern floral and faunal elements meet with western, and northern with southern—an area of hybridization and intergradation. Furthermore, the special habitat chosen by the bird is in itself intergrading and transitional and therefore very localized within the area.

Sight records and one specimen place the northernmost point of occurrence (as an accidental summer visitant) in southeastern Nebraska (Brunner, 1896). The species has been known to breed as far north as central Kansas but, though Tordoff (1956) lists two sight records in recent years, the status of the species in Kansas is uncertain. I visited localities in which the black-capped vireo had been found breeding and failed not only to find the species, but also to find any habitat comparable to that now occupied by the birds in other areas. I believe that land use (overgrazing) and climatic conditions (drought) have made the former habitat in

southern and southwestern Kansas unacceptable. The northernmost breeding area I have found is in northern Oklahoma (Major County).

The southernmost known breeding grounds are in central Coahuila, Mexico (Sierra Madera, east of Ocampo). This is also the western limit of breeding (103° W. Long.). The eastern limit is at approximately 97° W. Long. (Tulsa, Oklahoma, and Dallas, Texas).

The species winters along the west coast of Mexico from the foothills (at least as nigh as 2700 feet) of the Sierra Madre Occidental to the coast (Mazatlan, elevation 10 feet), from southern Sonora to Jalisco and Michoacan, and probably farther south. There are two records from Guerrero and one from Campeche. Observations by collectors for Dr. Robert T. Moore, by Dr. Allan R. Phillips, and by myself indicate that southern Sinaloa and Nayarit are the center of the wintering grounds. I saw more birds in Nayarit than in southern Sinaloa—as many as three in a square mile in a morning near Las Varas, Nayarit. Dr. Moore wrote me that though he had material from about the same number of collecting stations in Nayarit, Jalisco, Durango, and Sinaloa, about five times as many specimens had come from Sinaloa as from the other states.

All records known to me are listed in Table XII, which is arranged first by state, then alphabetically by county, and lastly by date. Maps II, III, IV, V, and VI show

the general location of records. Under several headings, I propose to discuss the distribution of the species as I know it now.

Oklahoma

At the time of this study, the black-capped vireo was known to breed in Caddo, Dewey, and Major counties. It was observed in Blaine and Canadian counties and it very likely breeds in these counties. It has been seen in Beaver, Cleveland, and Payne counties in summer. It may occasionally breed in the latter two, as well as in Oklahoma county.

The species has not been reported from Creek or Tulsa counties for over twenty years. I saw what looked like suitable habitat in the eroded sandstone hills of this region, but did not have time to search the area to my satisfaction.

The species no longer breeds in Comanche and Murray counties. Despite continued search, no one has found the bird recently in these counties. In both counties, the areas in which the bird was found have been much disturbed by the presence of people. In both the Arbuckle and the Wichita Mountains there are parks and resort areas. The Wichita area is further disturbed by bombardment of guns and by military manuevers on the military base nearby.

Special effort was made to find the species in Woodward, Woods, and Alfalfa counties, but none were seen there. The habitat in these counties may have been suitable at one

time, but is not so now because of overgrowth and thinning of shrubbery due to drought and overgrazing. In other words, the ravines in northern Oklahoma are now sparsely lined with medium-sized oaks and cedars, but there is insufficient cover at heights of two to six feet.

At present the species appears to be limited to eroded, red sandstone (Permian) ravines and canyons which support a scrubby growth of blackjack oak and post oaks and red cedar. The gypsum ravines of northern Oklahoma and southern Kansas which once supported populations of the black-capped vireo apparently no longer have suitable vegetation.

Texas

The black-capped vireo has been found locally throughout central Texas. The center of its distribution there lies in the hill country and Balcones Escarpment, an oak-cedar covered marginal portion of the Edwards Plateau.

As far as I have been able to determine, the bird now breeds no farther west than Devil's River in northwestern Valverde County and no farther south than central Uvalde County. In the southeast, the breeding range follows the line of the Balcones Escarpment through northern Bexar, eastern Comal, eastern Hays, and eastern Travis counties. Suitable habitat becomes sparse and spottily distributed north of the San Saba and Colorado Rivers. In fact, the only recent

records in northern Texas are from southwestern Dallas and northeastern Ellis counties.

To check reports of the species from eastern Texas in the "Big Thicket" area, I visited the eastern edge of this area which lies between the Trinity and Sabine Rivers south of Nacogdoches. I did not see any vegetation that was anything like that which the bird now occupies in other areas. Until specimens are taken in this region, I regard such reports as dubious. I have corresponded with several observers from Houston and none have ever seen the bird in the area, although Selle (1933, 1934) lists it in his books covering the Houston area (including the Big Thicket).

The species appears to have suffered severe reduction in numbers in the Trans-Pecos country and along the western edge of the Edwards Plateau. I made careful searches for the bird and for habitat that might attract it in the Davis, Chisos, and Glass mountains, and in Terrell, Crockett, western Valverde (Pecos River Gorge), Reagan, western Irion, Schleicher, Sutton, western Kimble, and San Angelo counties. I found remnants of the habitat in all these places, suggesting that in previous years they were suitable. Now the vegetation is almost gone because of drought.

For years the gorge near the mouth of the Pecos River has been occupied by black-capped vireos, but I could find none there in 1955 and 1956. A flood scoured the vegetation from the lower portion of the canyon in 1954, and drought has

killed most of the scrubby growth on the upper slopes. This shrubbery appeared to have been suitable habitat in earlier years, but in 1955 and 1956 stood dead and bare. In Ligon Canyon in Terrell County the same conditions prevailed. In the Chisos Mountains, half or more of the trees and shrubs living at the 5000-6000 ft. level, in 1955, were dead in 1956. The hillsides between Junction and Ozona had innumerable dead cedars and some dead oaks on them, all apparently killed by the drought.

Near Weatherford, Parker County, and through Palo Pinto and Stephens counties to Breckenridge there is some hilly terrain covered with cedar-oak growth that might offer suitable habitat. This sort of habitat also extends into southeastern Graham and southern Jack counties. I did not find any black-capped vireos at Possum Kingdom Lake. I did not check elsewhere in this area. In general the shrub growth appeared to be a little too thin to provide habitat for the species, but there well may be localized areas that are suitable.

A set of eggs allegedly collected in Cameron County, Texas, may or may not have been taken there. Baird (1874) lists Woodhouse's type as from El Paso—obviously an error (see page 1). There is no other record of the bird from El Paso.

Mexico

The first breeding record for Mexico is one by Renardo (1886) who wrote only that he found it breeding in the Rio Grande Valley. Specimens taken in May 1954 by University of Kansas collectors in central Coahuila indicated that it was breeding there. Other specimens taken in April and August suggested breeding, but since the species does not reach its northern breeding grounds until mid-April or later, and finishes breeding in the southern part of its range in July, these specimens might, it seemed, represent migrant or wandering birds. To make certain of the situation, and also to study the habitat of the southern part of the breeding range, I spent June, 1956, in central Coahuila. Breeding populations were found in two small mountain chains (Sierra Padilla and Sierra Madera) about Ocampo, Coahuila. Five nests were found.

Specimens taken in the Sierra del Carmen (Miller, 1955) and the Sierra del Pino (Van Hoose, 1955), which lie to the north of Ocampo, probably represent breeding populations. The Sierra del Pino extends into Chihuahua, so the species may breed in the eastern part of that state. I was not able to check the Sierra de los Alamitos or the Sierra de la Palma, both of which are a little south of the area in which I found the birds. I attempted to find the species in the mountains about Saltillo, still farther south. Here at 6500 feet, but not at lower elevations, there was some oak chaparral, but I

did not find the vireos. I speculate that the habitat was too cool at night for the species.

In reaching the mountains south and southwest of Hidalgo del Parral, I went first to San Francisco, then south in northwestern Durango through Rancho Blanco and Bojito (not on any maps in my possession including a U.S. Air Force aeronautical chart with a 1:1,000,000 scale) to the head of the Rio Verde (at the Continental Divide) and as far up into the mountains as a place called Las Flores, which lies between 9000 and 10,000 feet elevation and at which there are magnificent growths of pine. I particularly searched oak chaparral covered slopes lying just below the level of pinyon pine (about 5500 feet). I chose this area because it lies directly between the breeding grounds and the wintering grounds, and at the head of some of the rivers that lead to large barrancas through which black-capped vireos may be channeled in migration (Moore, 1938). It appears that the species must pass through this region, and if suitable habitat exists, it may stay to breed. However, I did not find it. The chaparral of the lower, warmer slopes had been largely destroyed by overgrazing and drought. That which might have been adequate on the upper slopes was probably at elevations too high for this species. Certain isolated areas may be suitable, but since few roads are passable in this region these areas may well remain undiscovered for some time.

The record from Santa Leonor, Tamaulipas (Phillips,

1911) suggests that the black-capped vireo may breed on the eastern slopes of Sierra Madre Oriental west of Ciudad Victoria, but to date no one has discovered it there. I have passed through Ciudad Victoria a number of times and have thought that the shrubby growth along the highway south of this city resembled that of the wintering grounds more than that of the breeding grounds. This record (if valid) may simply be one of accidental occurrence, a migrant that wandered astray.

Non-breeding birds have been found in Mexico between August 27 and March 20, and possibly can be found in April. Scattered locality records in September and March probably represent migrants, the rest, wintering birds. Moore (1938) has suggested that the black-capped vireo follows the Mexican plateau to the heads of river gorges leading westward to the coast, thus enabling it to by-pass the higher altitudes of the Sierra Madre Occidental. This well may be the case since this route is the shortest between the wintering and breeding grounds and it offers a way through at least some habitat not unlike that in which the bird winters and breeds.

However, scattered records also indicate that it is possible for the bird to pass over the mountains. One was taken at 9500 feet elevation on Volcan de Toluca. I, myself, took a captive to elevations between 9500 and 10,000 feet in the Colorado Rockies in late August, and found that the bird did not suffer if fed and kept warm at night. It seems that

a fattened migrant kept active by travel might well be able to pass over the Sierra Madre Occidental.

TABLE XII

DISTRIBUTIONAL RECORDS OF VIREO ATRICAPILLUS

(See Appendix I for abbreviations of names of museums)

Nebraska:

Locality	Date	Observer	Reference	Remarks
Douglas County				
Omaha	6/19/1894	I. S. Trostler	Brunner, 1896	One seen.
Sarpy County				
Bellevue		L. Skow	Brunner, 1896	
Meadow	5/19/1921	A. M. Brooking and J. E. Wallace		Specimen at HM.

Kansas:

Locality	Date	Observer	Reference	Remarks
Comanche County				
Near Rumsey Sect. 13, T34S, R16W	5/?/1885	N. S. Goss	Goss, 1885 Bunker, 1910 Douthitt, 1919	Two specimens at KSHS; one at KU. Nest found 5/11/85.

TABLE XII—Continued

Kansas—Continued

Locality	Date	Observer	Reference	Remarks
Cowley County				
Winfield	1902	L. T. Weeks	Fish & Wildlife Service Records	Common summer resident.
Winfield	4/22/1909		Cooke, 1909	Lists record.
Doniphan County				
Bendena	5/9/1917	F. B. Zimmerman	U.S. Fish & Wildlife Service Records	
Gray County				
Cimarron	9/2-10/1916	W. P. Woods	U.S. Fish & Wildlife Service Records	
Harvey County				
Halstead	5/16/1951	E. Ruth	Tordoff, 1956	Sight record.
Hodgeman County				
Arthur, Sect. 35, T21S, R24W				Set of eggs at BU.

TABLE XII—Continued

Kansas—Continued

Locality	Date	Observer	Reference	Remarks
Riley County				
Manhattan	6/18/1953	S. Searles	Tordoff, 1956	Sight record.

Oklahoma:

Locality	Date	Observer	Reference	Remarks
Beaver County				
Gate	5/5/1923	W. E. Lewis	Nice, 1931	Sight record.
Blaine County				
	1901-1903	C. D. Bunker	Bunker, 1910	Several specimens collected; a number of nests found.
Blaine County				
	6/27/1934	M. Leonard		Specimen at KU.
8 mi. N.W. of Watonga	6/3/1955	G. M. Sutton R. R. & J. Graber		Several seen.

TABLE XII—Continued

Oklahoma—Continued

Locality	Date	Observer	Reference	Remarks
Caddo County				
3 mi. S.W. of Cogar	4/26/1953	G. M. Sutton		Specimen at OU.
3 mi. S.W. of Cogar	4/25/1954 to 9/17/1954	R. R. & J. Graber G. M. Sutton		Four specimens taken. A number of nests found.
3 mi. S.W. of Cogar	4/17/1955 to 8/3/1955	R. R. & J. Graber		A number of nests found. Set of eggs at OU.
3 mi. S.W. of Cogar	5/31/1956 to 6/5/1956, 7/22-29/1956, and 8/2/1956	R. R. & J. Graber		Fourteen nests of 12 pairs found. Specimens taken: 1 skin, 2 skeletons, 2 alcoholics.
Canadian County				
4 mi. S.E. of Hinton, Devil's Canyon	5/3/1953	R. R. Graber D. F. Parmelee		Pair seen.

TABLE XII—Continued

Oklahoma—Continued

Locality	Date	Observer	Reference	Remarks
Cleveland County				
Norman	5/11/1926	M. M. Nice	Nice, 1931	Sight record.
15 mi. E. of Norman	6/2/1955	G. M. Sutton J. C. Johnson, Jr.		Sight record.
15 mi. E. of Norman	6/5/1955 and 6/15/1955	J. Graber		Single male on territory, had built rim of nest.
Comanche County				
Lower Narrows of W. Cache Creek in Wichita Mts.	6/4-5/1929	M. M. Nice	Nice, 1929	A singing male seen.
Cache	6/19/1937	T. D. Burleigh		Specimens at USNM.
Creek County				
Sapulpa	7/20/1929	T. R. Beard	Nice, 1931	Two nests. No evidence.

TABLE XII—Continued

Oklahoma—Continued

Locality	Date	Observer	Reference	Remarks
Dewey County				
12 mi. S.E. of Seiling	5/13/1955	G. M. Sutton		Pair collected.
12 mi. S.E. of Seiling	5/24/1955	G. M. Sutton		Found nest newly built.
12 mi. S.E. of Seiling	6/3/1955	J. Graber		Banded pair.
12 mi. S.E. of Seiling	8/2/1955	R. R. and J. Graber		Saw male again.
Major County				
6 miles E. of Chester	7/12/1955	R. R. and J. Graber		Found nest, banded pair.
	8/2/1955	R. R. and J. Graber		Banded one juv. from this nest.
Murray County				
Arbuckle Mts.	6/17/1920	M. M. Nice	Nice, 1931	Sight record.
Arbuckle Mts.	4/23/1927	M. M. Nice	Nice, 1931	Found nest with tiny chicks.

TABLE XII—Continued

Oklahoma—Continued

Locality	Date	Observer	Reference	Remarks
Murray County				
Arbuckle Mts.	4/26-27/1937	G. M. Sutton K. W. Haller		Several specimens. Sutton made photo of nest (unpublished).
Oklahoma County				
Spencer	5/2/1938 and 5/9/1938	J. W. Harmon	Fish and Wild Life Service records	Pair building nest.
Payne County				
Lake Carl Blackwell	5/20/1942	F. M. Baumgartner	Baumgartner, 1944	Male singing, not seen thereafter.
Tulsa County				
Near Tulsa	1926 1927	G. W. Morse	Morse, 1927 Nice, 1931	Found three nests. Eggshells and nest at MVZ.
Near Tulsa	5/12/?	H. A. Yocum	Yocum, 1935	Nesting.
Tulsa	5/20 to 7/20 (1930)	E. R. Force	Force and Hughes, 1940	

TABLE XII—Continued

Texas:

Locality	Date	Observer	Reference	Remarks
Bandera County				
	3/19/1884	G. H. Ragsdale	Cooke, 1888	I have not located this specimen.
Bastrop County				
Slum (Alum) Creek about 4 mi. N.W. of Smithville		J. A. Singley	Singley, 1887	Found nest.
Brewster County				
Glass Mts. 15 miles N.E. of Marathon	April 1933	G. M. Sutton	Van Tyne and Sutton, 1937.	
	4/25/1935	G. M. Sutton	Van Tyne and Sutton, 1937.	Specimens at CM.
Chisos Mts. Blue Creek	4/30/1936	T. F. Smith	Oberholser	Sight record. Pair seen.
Chisos Mts. Lost Mine Trail	4/30/1949	A. D. Cruickshank	Cruickshank	Sight record. One seen.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Bexar County				
San Antonio	3/31/1890	_____		Specimen at USNM.
Balcones Escarp. 23 mi. W. of San Antonio	4/25/1889	_____		Specimen at USNM.
18 mi. W. of San Antonio	6/8/1890	H. P. Attwater		Specimen at AMNH.
San Antonio	5/4/1898	P. W. Smith, Jr.	Fish & Wildlife Service records	Nesting, 3 eggs.
West and N.W. of San Antonio	_____	H. P. Attwater	Attwater	Reported nesting.
_____	_____	_____	A. J. Kirn and R. W. Quillin, 1927	
N.W. of Classen on W. Fork of Cibolo Creek	6/20/1936	R. W. Quillin	Fish and Wildlife Service records	Nest with 3 eggs reported.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Burnett County				
San Gabriel Ridge	1898	V. Bailey	Oberholser	Observer heard several.
Callahan County				
Putnam	5/1/1926	A. J. Kirn	Fish & Wildlife Service records	Sight record.
Cameron County				
Brownsville	May 1892	F. B. Armstrong	Specimen in Catalogue PAC	Set of eggs at USNM.
Comal County				
23 mi. N.E. of New Braunfels	5/6/1878	W. H. Werner	Coues, 1879	Specimen at USNM.
_____	5/15/1880	E. F. Friedley		Egg set at AMNH.
_____	6/12/1881	E. F. Friedley		Egg set at AMNH.
_____	5/20/1884	G. B. Benners	Benners, 1887	Set of eggs at USNM.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Comal County				
_____	5/17/1885	E. F. Friedley		Set of eggs at AMNH.
_____	April, 1888	T. S. Gillin		Several (6) specimens and a nest at PMZ.
_____	5/29/1888	G. B. Benners		Set of eggs at USNM.
El Rancho Cima 5 mi. W. of Wimberley	3/24/1956 5/4-25/1956 6-7-1956 7/2-10/1956	J. Graber		Sight record. Found 18 nests. No specimens. Photos made.
Comanche County				
50 mi. N.E. of Camp Verde	5/2/1878	G. H. Ragsdale	Deane, 1879	This specimen used to be at PM. Has disappeared.
_____	_____	_____	H. Nehrling	Reported breeding.
Concho County				
_____	_____	_____	W. Lloyd, 1887	

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Cooke County				
Red River near Warren's Bend	6/16-17/1880	G. H. Ragsdale	Ragsdale	Young just out of nest.
_____	6/25/1880	G. H. Ragsdale		Specimen used to be at PM. Has disappeared.
_____	5/29/1888	G. H. Ragsdale		Specimen at UMMZ.
Gainesville	4/17/1885	(Ragsdale)	Cooke, 1888	
Gainesville	_____	_____		Specimen at CMNH.
Dallas County				
Southwestern part of county	1930 to 1956	J. E. Stillwell	Stillwell, 1939	Lists as summer resident.
_____	4/1 to 9/5	C. Kelley	Kelley, 1935	Lists as uncommon; nesting.
Boy Scout Camp west of Duncanville and Campfire Girls' Camp near Cedar Hill.	May to July 1937 1946	C. T. Gill		Sight records.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Dallas County				
Near Cedar Hill	5/11/1938	Mrs. T. E. Winford		Saw young birds just out of nest.
Mountain Creek	5/ / 1945 4-5/ / 1952	Mrs. Winford and Mrs. Kennedy England		Sight records.
15 mi. S.W. of Dallas	5/21-22/1956	J. E. Stillwell		Sight records.
2½ mi. N. of Cedar Hill	8/7/1956	E. C. Fritz		Sight record.
Near Duncanville	8/11/1956	Geth Osborne		Sight record.
Near Duncanville	9/3/1956	E. C. Fritz and G. Osborne		Sight record.
Eastland County				
Cisco	4/29/1926	A. J. Kirn	Fish & Wildlife Service records	Pair seen.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Edwards County				
7 mi. S. of Rock Springs	7/14/1902	M. Cary		Specimen at USNM.
9 mi. N.E. of Rock Springs	1950-1956	E. B. Kincaid, Jr.		Sight records.
Ellis County				
Near Midlothian	May to July 1937 to 1946	C. T. Gill		Sight records.
Erath County				
Northeastern part of Co.	5/3/1878	G. H. Ragsdale	Deane, 1879	I have not located any specimen.
Fayette County				
_____	_____	H. Nehrling	Nehrling, 1896	Sight record
Gillespie County				
Fredericksburg (Baron Springs)	9/11/1894	F. Grasso	Fish and Wildlife Service records	

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Hays County				
El Rancho Cima, Boy Scouts of America Houston Council Area	6/23/1955	Carl Aiken		Saw several.
El Rancho Cima, Boy Scouts of America Houston Council Area	3/24/1956 5/4-25/1956 6/7/1956 7/2-10/1956	R. R. & J. Graber		Several nests found.
2 mi. S. of Wimberley	3/25/1956 April, May, and July, 1956	J. Graber		Several seen; specimen taken 7/9/56.
2 mi. E. of Wimberley, Thornton Ranch	3/26/1956 April, May, and July, 1956	J. Graber		Several nests found. At least six resident males.
Kendall County				
Boerne	3/27/1880	N. C. Brown	Brown, 1882	Specimen at PU.
Boerne	5/20/1892	F. M. Woodruff	Fish & Wildlife Service records.	Specimen at CAS.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Kerr County				
Turtle Creek	6/3/1896	H. Lacey	Lacey, 1911	Egg set at USNM.
Kerrville	5/7/1899	V. Bailey		Egg set at USNM also specimen.
Turtle Creek	5/5-7/1900	H. P. Attwater		Egg set at USNM also specimen at DMNH.
Japonica	1902	V. Bailey		Specimens; see Appendix II for list of specimens.
Kerrville	1907	A. P. Smith		
Kerrville	1910	J. E. Thayer		Specimen at BU.
Lacey's Ranch near Kerrville	1910	A. P. Smith		Specimens.
Ingram Kerrville	1910	F. B. Armstrong		Specimen at CAS
Kerrville	5/6/1915	F. B. Armstrong		Egg set at YPM, also specimens.
Ingram	1915	A. P. Smith		Specimens.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Kerr County				
Kerrville	1917	H. Lacey	Fish and Wildlife Service records	
Kerrville	6/10/1932	T. Smith	Fish and Wildlife Service records	Nesting record.
8 mi. S. W. of Kerrville	1937	B. E. Ludeman		Specimens, see Appendix II.
20 mi. W. of Mountain Home	1937	D. W. Lay		Specimen.
12 mi. S.W. of Kerrville	1940	A. C. Twomey		Specimens.
Kerrville	1953-1954	L. R. Wolfe		Sight records.
Kerrville	8/28/1955	R. R. and J. Graber		Saw two males and one female.
Kimble County				
Junction	5/6/1939	T. D. Burleigh		Specimen at USNM.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Kinney County				
25 mi. N. of Brackettville, Ted F. Dunham Ranch	7/13/1956	R. R. Graber		Specimen.
Lee County				
_____	_____	Nehrling	Nehrling, 1896	
Llano County				
Ridge overlooking Inks Lake	7/16/1956	R. R. & J. Graber		Sight record.
Mason County				
	1890	I. B. Henry	Oberholser	Reported rare, breeds.
McLennan County				
Near Crawford on Bluff Creek		C. D. Oldright J. K. Strecker	Strecker, 1927	Strecker saw only 6 during 35 years.
Bosque Hills near Waco	6/3/1935 and 6/13/1935	T. F. Smith		Specimens at YPM.
Waco	_____	_____		Set of eggs at BU.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Medina County				
Camp Verde	4/20/1878	Norris	Deane, 1879	The present Camp Verde is in Kerr County.
Diversion Lake	4/3/1926	A. J. Kirn	Fish and Wildlife Service records	Pair seen.
18 mi. N. of Castroville	5/27/1927	A. J. Kirn	Fish and Wildlife Service records	Nesting; several nests found.
18 mi. N. of Castroville	6/24/1930	A. J. Kirn		
Rio Medina	6/25/1931	H. W. Brandt	Fish and Wildlife Service records	I have not located this specimen.
Diversion Lake	6/9/1931	A. J. Kirn	Fish and Wildlife Service records	Nesting.
6 mi. N.W. of Rio Medina	5/26/1934	A. J. Kirn		Specimen at UMMZ. Nest found.
Ney Cave, 20 mi. N. of Hondo	5/9/1953	E. B. Kincaid, Jr.		Five seen.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Menard County				
San Saba River near Menard	5/7/1918	A. P. Smith	Smith, 1918	I have not located any specimen.
Reagan County				
Near head of Concho River	1883-1886	W. L. Lloyd	Oberholser	Reported breeding.
Real County				
Prade Ranch	1933	R. W. Quillin	Oberholser	Sight record.
Tarrant County				
	1915	R. Graham	Graham, 1915	Lists as breeding, but omits from subsequent lists.
Fort Worth	6/27/1916		Fish and Wildlife service records	One pair reported nesting.
Fort Worth	May 1937	Mrs. Wade Smith (W. M. Pulich		Sight record.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Terrell County				
13 mi. S. of Sheffield, Ligon Canyon	6/15/1949	W. A. Thornton	Thornton, 1951	Specimen at TU.
Tom Green County				
San Angelo	9/6/1884 9/16/1885		Cooke, 1909	
	8/26/1886 9/1/1886	W. Lloyd	Lloyd, 1887	Specimens at USNM. Nesting reported.
Travis County				
Austin	4/22/1889	C. D. Oldright		Specimen at AMNH.
Austin	4/16-17/1893		Fish & Wildlife Service records	
Along Barton Creek at Marshall Dam	1941	Mrs. Lovie Whitaker		Sight records.
15 mi. N.W. of Austin	1945-1946	R. Bedicheck		Reported nest.
On W. side of Austin	1950-1953	E. B. Kincaid, Jr.		Sight records.

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Travis County				
Near Austin	7/17/1956	F. S. Webster R. R. & J. Graber		Saw two males.
Taylors Slough near Lake Austin	9/17/1956	F. S. Webster		Saw one.
Uvalde County				
Near Sabinal	5/1/1953	E. B. Kincaid, Jr.		Sight record.
18 mi. S. of Leakey, Menada Ranch	1955 1956	R. R. & J. Graber		Saw several. Specimen taken.
Valverde County				
San Pedro River	May 1851	Woodhouse	Sitgreaves Report, 1854	Specimen at AMNH.
San Pedro River	(June) "1850"	J. R. Clark	Cassin, 1862	Specimen at USNM.
Rio San Pedro	5/6/1878			
Devil's River	7/22-23/1902	M. Cary		Specimens at USNM.
Pecos River	8/4/1902	M. Cary		

TABLE XII—Continued

Texas—Continued

Locality	Date	Observer	Reference	Remarks
Valverde County				
Langtry	4/26/1901	H. C. Oberholser		Specimen at USNM.
Mouth of Pecos River	5/22/1900	V. Bailey	Bailey, 1902	Specimen at USNM. Nesting.
Mouth of Pecos River	8/27-28/1890	W. Lloyd		Specimens at USNM.
Comstock	4/23/1901	L. A. Fuertes		Specimen at CU.
Mouth of Pecos River	5/24/1938	G. H. Lowery, Jr.		Specimen at LSU.

Campeche, MEXICO

Locality	Date	Observer	Reference	Remarks
	1880's	J. Renardo	Renardo, 1886	Seen in winter.

TABLE XII—Continued

Coahuila, Mexico

Locality	Date	Observer	Reference	Remarks
Sabinas	4/19/1910	H. H. Kimball		Specimen at MVZ.
Sierra del Pino, elev. 5250 ft.; 6 mi. W. of Acebuches	7/3/1952	S. Anderson	Van Hoose, 1955	Specimens at KU.
Sierra del Carmen, elev. 5000 ft.; 5 mi. W. of Piedra Blanca	4/23-27/1953	A. H. Miller	Miller, 1955	Specimens at MVZ.
Sierra Padilla, 16 mi. E., 18 mi. N. of Ocampo	5/8-9/1954	H. W. Dickerman	Van Hoose, 1955	Specimens at KU.
Sierra Padilla, 16 mi. E., 18 mi. N. of Ocampo	6/13-14/1956	R. R. Graber, J. Graber, and H. C. Land		Two nests found. One held 4 young about 6 days old.
Sierra Madera, 32 mi. by road westward from Ocampo, Coah., through LaPasa, San Pedro, Buenos Aires and LaCruz	6/17-18/1956	R. R. Graber, J. Graber, and H. C. Land		Three nests found. Two with eggs, one just completed.

TABLE XII—Continued

Durango, Mexico

Locality	Date	Observer	Reference	Remarks
Rancho Guasimal, on lat. 25 6 mi. W. of Birimoa which lies northwest of Tamazula	10/21/1937 11/13/1937	C. C. Lamb		Specimens in MC:OC.
Three kilometers (1.8 mile) N.E. of Tamazula	11/21/1937 12/10/1937	C. C. Lamb		Specimens in MC:OC.

Guerrero, Mexico

Locality	Date	Observer	Reference	Remarks
Rincon	1888	Mrs. H. Smith		Specimen in BM.
Chilpancingo	3/2/1940	W. W. Brown		Specimen at MVZ.

TABLE XII—Continued

Jalisco, Mexico

Locality	Date	Observer	Reference	Remarks
Guadalajara, Barranca de Portillo	1/12/1891	A. C. Butler		Specimen at AMNH.
Sapotillo, 22 mi. S.W. of Autlan	2/19/1952 2/21/1952	C. C. Lamb		Specimens in MC:OC.
San Sebastian (which lies south of Tepic, Nayarit)	3/19/1955	A. R. Phillips		Sight record.

Mexico, Mexico

Locality	Date	Observer	Reference	Remarks
North slope of Volcan de Toluca near Mexico City, elev. 9500 ft.	9/11/1893	E. W. Nelson	Fish & Wildlife Service records	Specimen at USNM.

Michoacan, Mexico

Locality	Date	Observer	Reference	Remarks
Ten miles N.W. of Tiquicheo (which lies N.W. of Huetamo)	1/1/1953	C. C. Lamb		Specimen in MC:OC.

TABLE XII—Continued

Morelos, Mexico

Locality	Date	Observer	Reference	Remarks
South slope of Cerro Cuautepetl (north of Cuernavaca, west of Huitxilac)	4/6/1954	D. W. Warner		Specimen at MMMH.

Nayarit, Mexico

Locality	Date	Observer	Reference	Remarks
Three and a half mi. S.W. of Tepic	8/27/1938	C. C. Lamb		Specimen in MC:OC.
Chacala (which lies south of San Blas, west of Las Varas)	3/15/1941	C. C. Lamb		Specimen in MC:OC.
San Blas	3/19/1948	C. C. Lamb		Specimen in MC:OC.
One mi. W., 6 mi. S. of Compostela	11/30/1952	A. R. Phillips		Specimen at MT.
Near Las Varas (which lies west of Compostela)	11/16-25-28/ 1952	A. R. Phillips		Specimens at MT.
Fourteen and a half mi. W. of Tepic, elev. 2700 ft.	10/8/1955	A. R. Phillips		Specimen at MT.

TABLE XII—Continued

Nayarit, Mexico—Continued

Locality	Date	Observer	Reference	Remarks
N.N.E. of Santa Maria del Oro (which lies S.E. of Tepic)	10/10/1955	A. R. Phillips		Sight record.
Las Varas	12/28-29/1956	R. R. and J. Graber		Specimens at OU.

Sinaloa, Mexico

Locality	Date	Observer	Reference	Remarks
Mazatlan	April 1860's	A. J. Grayson		Specimen at USNM.
Rosario	12/18/1933 1/6/1934 2/26/1935	C. C. Lamb		Specimens in MC:OC.
Chele (S.W. of Concordia, W. of Villa Union)	2/9/1935 2/15/1935	C. C. Lamb		Specimens in MC:OC.
San Ignacio (N. of Mazatlan about halfway to Culiacan)	3/18/1937 3/20/1937	C. C. Lamb		Specimens in MC:OC.
Iguana	2/21/1938	C. C. Lamb		Specimen in MC:OC.

TABLE XII—Continued

Sinaloa, Mexico—Continued

Locality	Date	Observer	Reference	Remarks
Copala (N.E. of Concordia) elev. 1200 ft.	1/13/1947 1/25/1947	K. E. Stager		Specimens at LACM.
Concordia (3 mi. W.)	12/21/1955	R. R. and J. Graber		Specimen at OU.

Sonora, Mexico

Locality	Date	Observer	Reference	Remarks
Ciudad Obregon	Nov. 1955	A. R. Phillips		Sight record.

San Luis Potosi, Mexico

Locality	Date	Observer	Reference	Remarks
Twenty miles south of Valles	Easter 1947	I. R. Davis		Sight record.

Tamaulipas, Mexico

Locality	Date	Observer	Reference	Remarks
Santa Leonor (11 mi. N.W. of Ciudad Victoria)	4/12/1908	F. B. Armstrong	Phillips, 1911	I have not located this specimen.

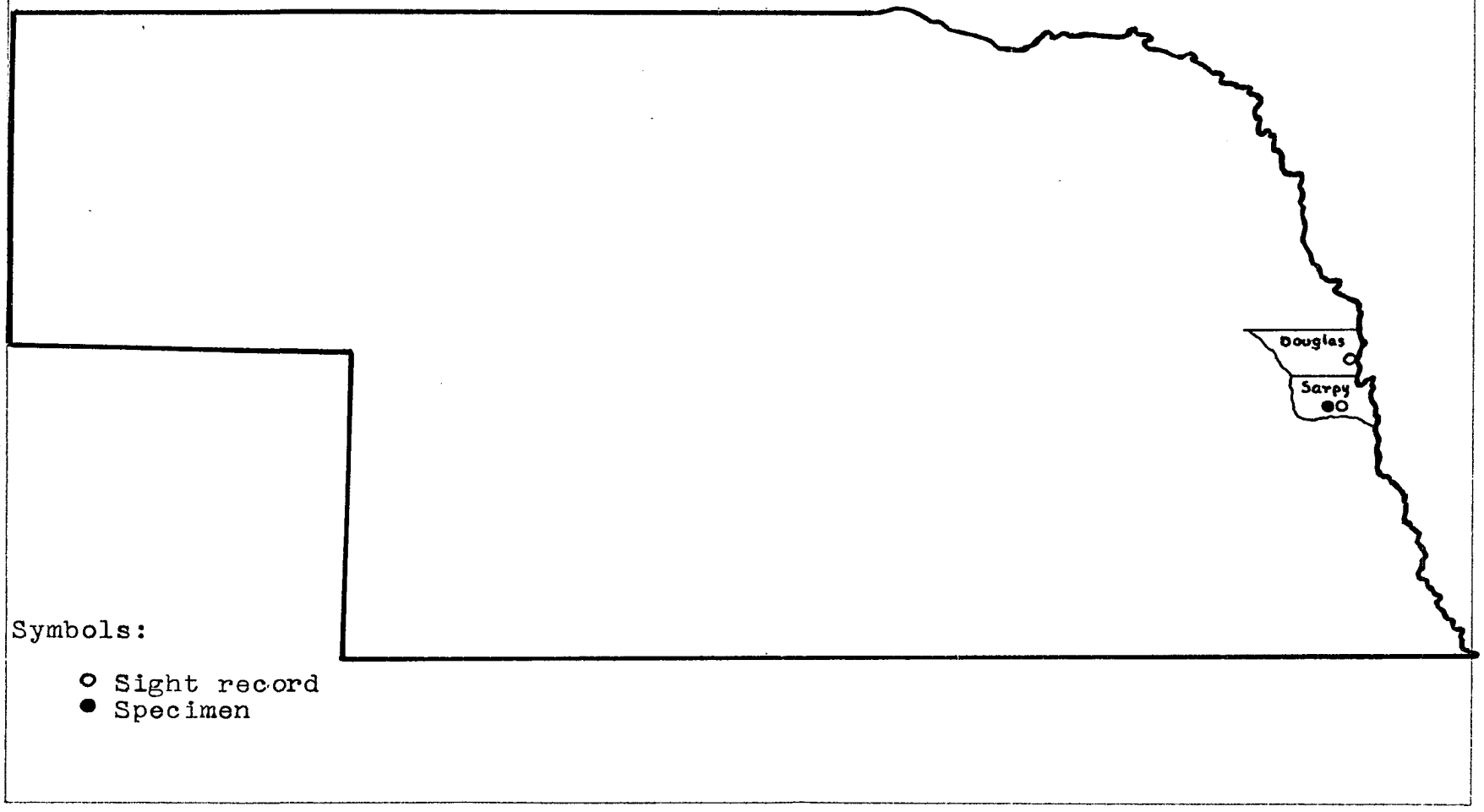
TABLE XII—Continued

Mexico

Locality	Date	Observer	Reference	Remarks
Rio Grande Valley	1880's	J. Renardo	Renardo, 1886	Reported nesting.

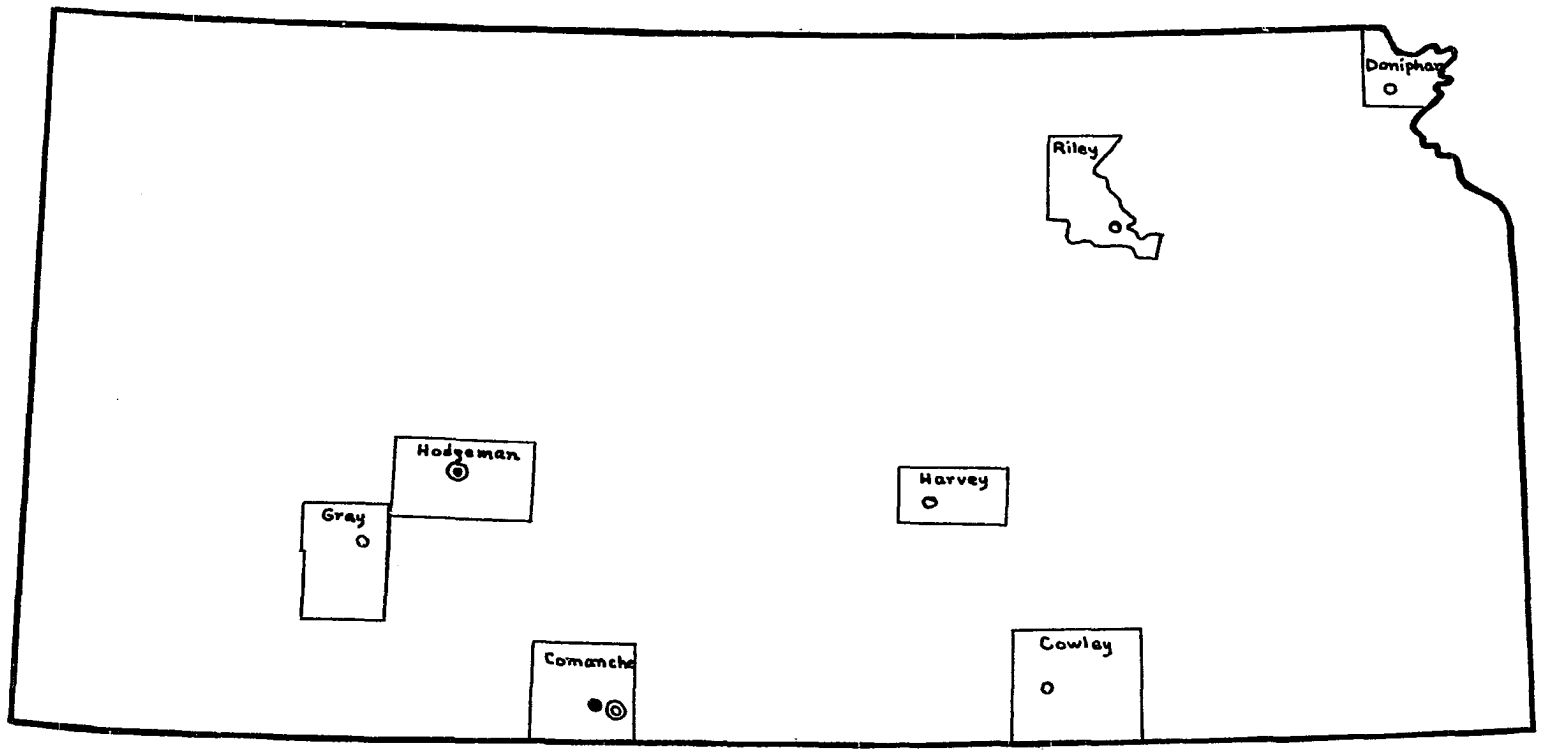
MAP II

DISTRIBUTION OF VIREO ATRICAPILLUS RECORDS IN NEBRASKA



MAP III

DISTRIBUTION OF VIREO ATRICAPILLUS RECORDS IN KANSAS

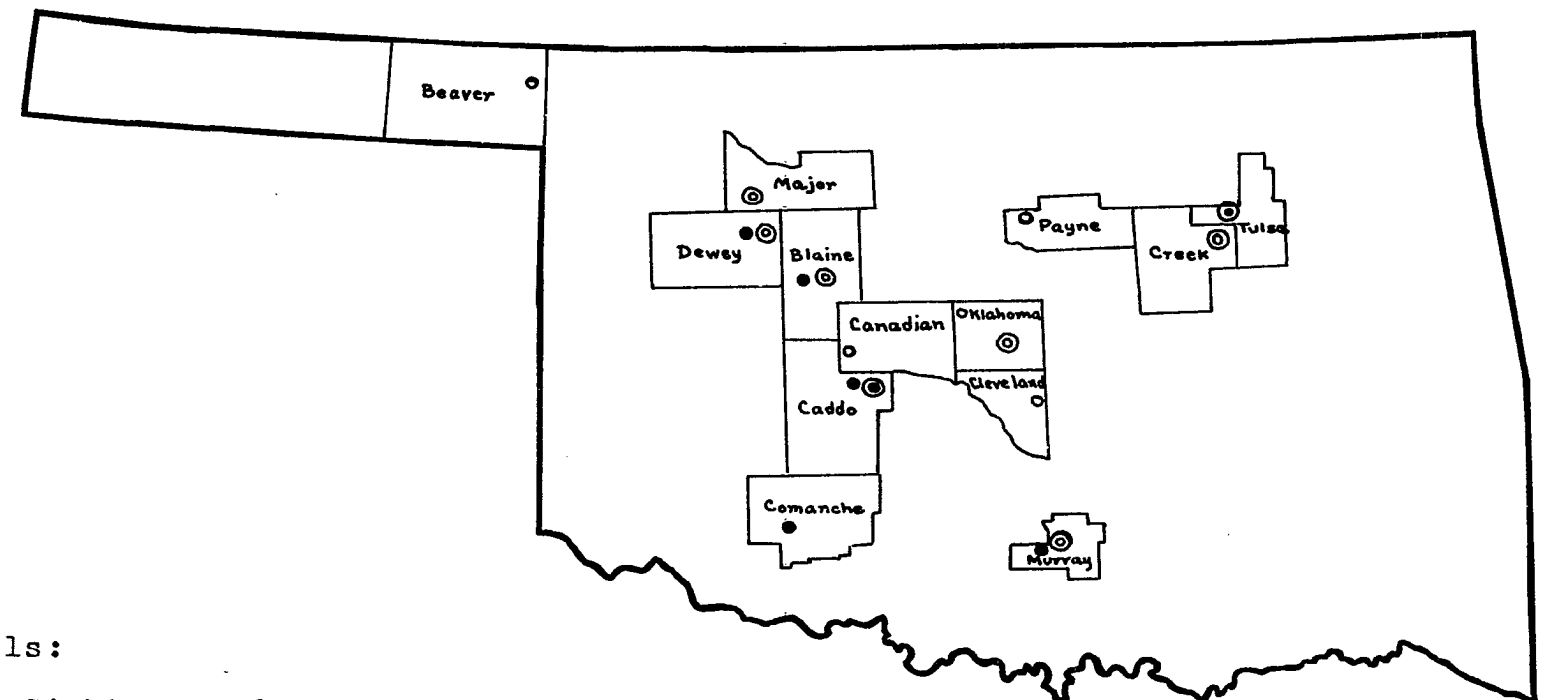


Symbols:

- ○ Sight record
- ● Specimen
- ◎ Eggs, nest, or juvenile specimens
- ◎ Nesting reported

MAP IV

DISTRIBUTION OF VIREO ATRICAPILLUS RECORDS IN OKLAHOMA

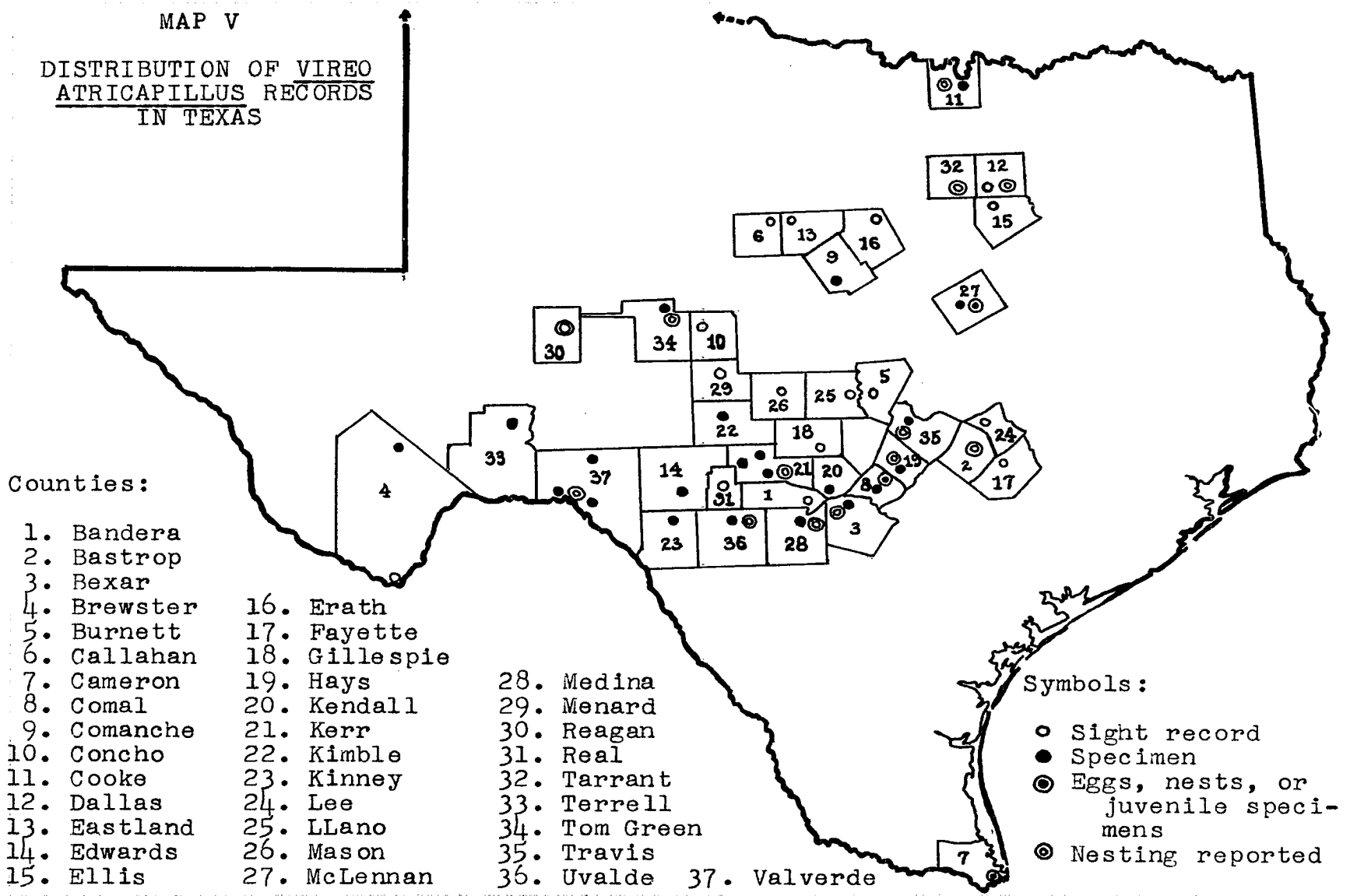


Symbols:

- ○ Sight record
- ● Specimen
- ◎ Nest, eggs or juvenile specimens
- ◎ Nesting reported

MAP V

DISTRIBUTION OF VIREO ATRICAPILLUS RECORDS IN TEXAS



Counties:

1. Bandera
2. Bastrop
3. Bexar
4. Brewster
5. Burnett
6. Callahan
7. Cameron
8. Comal
9. Comanche
10. Concho
11. Cooke
12. Dallas
13. Eastland
14. Edwards
15. Ellis
16. Erath
17. Fayette
18. Gillespie
19. Hays
20. Kendall
21. Kerr
22. Kimble
23. Kinney
24. Lee
25. LLano
26. Mason
27. McLennan
28. Medina
29. Menard
30. Reagan
31. Real
32. Tarrant
33. Terrell
34. Tom Green
35. Travis
36. Uvalde
37. Valverde

Symbols:

- ○ Sight record
- ● Specimen
- ◉ Eggs, nests, or juvenile specimens
- ◎ Nesting reported

MAP VI

DISTRIBUTION OF VIREO ATRICAPILLUS
RECORDS IN MEXICO



CHAPTER IX

OTHER VERTEBRATES IN AREA OCCUPIED BY BLACK-CAPPED VIREO AND ITS RELATION TO THEM

In Oklahoma, the snakes I saw in the area occupied by the black-capped vireo were copperheads (Ancistrodon contortrix), coachwhips (Masticophis flagellum), kingsnakes (Lampropeltis calligaster), and blacksnakes (Elaphe obsoleta). Though I suspected predation by snakes in a number of cases in which nest contents disappeared, I witnessed it only once. On June 10, 1955, I caught a blacksnake in the act of swallowing a nestful of young vireos which were about nine days old. The vireos reacted strongly toward coachwhips whenever they saw them, scolding and snapping their bills.

In Texas, I found rattlesnakes (Crotalus atrox), coachwhips (Masticophis taeniatus), green snakes (Opheodrys aestivus), and patch-nosed snakes (Salvadora grahamiae) about the nesting areas of the vireo. Upon finding a coachwhip in the same bush in which a black-capped vireo nest had recently been robbed, I killed the snake and found five lizards in its stomach.

Mammals seen in the Oklahoma study area were fox squirrels (Sciurus niger), cottontail rabbits (Sylvilagus floridanus), rats (Neotoma sp.), opossums (Didelphis virginiana), raccoons (Procyon lotor), skunks (Mephitis mephitis), and red foxes (Vulpes fulva). One vireo nest was destroyed by a fox squirrel. Mammals other than rodents were not numerous in the area. In Texas, only rabbits (Sylvilagus floridanus and Lepus californicus) and deer (Odocoileus virginianus) were numerous. The vireos placed their nests higher in deer-browsed than in unbrowsed shrubbery.

Birds which occupied the same habitat as the black-capped vireo in Oklahoma were the bobwhite (Colinus virginianus), mourning dove (Zenaidura macroura), yellow-billed cuckoo (Coccyzus americanus), roadrunner (Geococcyx californianus), chuck-will's-widow (Caprimulgus carolinensis), poor-will (Phalaenoptilus nuttallii), downy woodpecker (Dendrocopos pubescens), Carolina chickadee (Parus carolinensis), tufted titmouse (Parus bicolor), Bewick's wren (Thryomanes bewickii), blue-gray gnatcatcher (Polioptila caerulea), Bell's vireo (Vireo bellii), black and white warbler (Mniotilta varia), prairie warbler (Dendroica discolor), yellow-breasted chat (Icteria virens), cowbird (Molothrus ater), cardinal (Richmondena cardinalis), blue grosbeak (Guiraca caerulea), painted bunting (Passerina ciris), lark sparrow (Chondestes grammacus), and field sparrow (Spizella pusilla).

In Texas, the mourning dove, ground dove (Columbigallina passerina), ladder-backed woodpecker (Dendrocopos scalaris), black-crested titmouse (Parus atricristatus), Bewick's wren, mockingbird (Mimus polyglottos), blue-gray gnatcatcher, white-eyed vireo (Vireo griseus), Bell's vireo, yellow-breasted chat, cowbird, cardinal, painted bunting, house finch (Carpodacus mexicanus), rufous-crowned sparrow (Aimophila ruficeps), lark sparrow, and field sparrow were found in the same area as the black-capped vireo. In some localities the scrub jay (Aphelocoma coerulescens), black and white warbler, and golden-cheeked warbler (Dendroica chrysoparia) and black-throated sparrow (Amphispiza bilineata) are found in the black-capped vireo's habitat.

In Mexico (Coahuila), the mourning dove, ladder-backed woodpecker, scrub jay, bush-tit (Psaltriparus minimus), Bewick's wren, mockingbird, gnatcatcher, black-headed grosbeak (Pheucticus melanocephalus), house finch, Mexican goldfinch (Spinus psaltria), rufous-sided towhee (Pipilo erythrophthalmus), and rufous-crowned sparrow occupied the black-capped vireo's habitat.

Although the ecological niches of the black-capped, Bell's, and white-eyed vireos meet and overlap slightly, there apparently is no aggression in their competition. I never witnessed any fighting between black-capped and white-eyed vireos whose territories clearly overlapped, or between Bell's and black-capped vireos on overlapping territories.

Bunker (1910) reported finding a nest of the Bell's vireo and one of the black-capped vireo in the same bush. The two species (I have never seen overlapping of territories of all three species, though all three can be found in one locality and in such a locality territories of two of the three may overlap) appear to ignore each other, each going about its daily activities as if the other were not present. I found no evidence of interbreeding between these species. The habitats of Hutton's vireo (Vireo huttoni) and the gray vireo (V. vicinior) differ more from that of the black-capped vireo than do those of the Bell's and white-eyed vireos. In Coahuila, Mexico, these five vireos separate nicely into different levels and habitats. The Bell's occupies the mesquite lowlands between the mountains; the white-eyed, more mesic lowlands; the gray, juniper (Juniperus monosperma) lowlands and low hillsides; the black-capped, slopes at 3000 to 5000 feet covered with low oak mottes; the Hutton's, the pinyon and pine level above that of the black-capped. The Hutton's and gray are western in distribution, meeting the black-capped at the eastern edge of their range. The white-eyed is more eastern in its distribution, meeting the black-capped at the western edge of its range. The Bell's has a wide, somewhat central, distribution.

I seldom saw the black-capped vireo attack any other species of bird. Once I saw a male pounce on a blue-gray gnatcatcher, and another time I saw one fly at a field

sparrow.

Few birds of prey bother them. In three years time, only one male under observation disappeared during the breeding season, and I think it likely that he may have met an accidental death, as he had a roadside territory and was in the habit of flying across a busy highway. The cowbird is the species' greatest predator. On several occasions I have seen a female vireo open her mouth in an aggressive manner at a female cowbird that ventured near the nest while the vireo was on it.

Cowbirds are definitely destructive as far as this vireo is concerned. The greatest losses during the nesting season are caused by cowbirds (see page 56). I have seen a female cowbird attack a nestful of young vireos so savagely that, had I not intervened, she would probably have killed one or more of the young birds. I do not think that the cowbird attacked the young to destroy the nest and thus bring about re-nesting—a procedure suggested to occur in the old-world cuckoo (Cuculus canorus) (Witherby et al., 1948). Rather, I believe it was an attempt to drive a bird (the young were ten days old) off its nest. The cowbird could then inspect the nest for laying in the morning (the attack took place at 6:20 p.m.). An incident of a cowbird attacking a yellow warbler (Dendroica petechia) on its nest has been reported (Hoyt, 1948).

The black-capped vireo is not very successful in

rearing cowbirds. During the course of this study, only four cowbird chicks were reared to the point of leaving the nest, and I saw none of these being fed more than one day afterwards. When two cowbird chicks are hatched in a nest, neither survives. Often the nest breaks loose from its moorings because of the weight of the chicks. If not, a predator gets the chicks. The food-cries of a large cowbird chick attract predators. The vireos seem to be unable to adequately feed two cowbird chicks in the nest or one large enough to leave the nest.

The black-capped vireo does not bury the cowbird egg under a new nest-floor as does the yellow warbler. I found one nest in which the cowbird egg was partly buried but the cowbird may have laid this egg before the nest was completed. When a cowbird egg is deposited before the nest-lining is put in, the vireos usually add only a little material as lining.

CHAPTER X

HABITAT

Vegetation of Breeding Habitat

The black-capped vireo breeds in scrubby tree growth of the forest-grassland ecotone in the area of transition between Merriam's Austroriparian and Lower Sonoran Zones. The extent and height of this dwarf forest habitat is largely determined by climatic, edaphic, and topographical factors, but is also affected by secondary factors like fire, grazing, and human disturbance.

Along the northern and western edge of the range suitable habitat occurs in ravines which provide more mesic conditions than the prairie upland. On the eastern edge of the range weathered and eroded highlands and stream boundaries (above the flood plains) provide edaphic conditions for suitable vegetation. Southward the habitat occupies hilltops and mountain slopes to over 6000 feet. Thus the black-capped vireo has been found in prairie ravines in Kansas, in canyons like that of the Pecos River in western Texas, on eroded sandstone slopes in Oklahoma, on the hills of the Edwards

Plateau, and on mountainsides in Brewster County, Texas, and in central Coahuila, Mexico.

Areas supporting a climax unsuitable chiefly because of size and stand are rendered satisfactory by fire and cutting of trees. I have found black-capped vireos so often on burns that I am convinced that the burning practiced by the Indians of the plains probably aided in the dispersal of this species. In recent times man has provided habitat by chopping down large trees, e.g., the cedars of the Texas hill country which have formed brakes so dense no shrub understory could develop.

Overgrazing has aided weathering and erosion so that coarse soils favoring scrub growth have replaced richer grassland soils. Browsing by goats, which have been introduced in numbers in Texas within the last half century, reduces the habitat. Deer browse does not bother the bird (see page 132). Nests are frequently placed in cedar and evergreen sumac (Rhus virens) in overgrazed pastures, as these plants are not eaten by cattle which do browse on the small live oaks (Quercus virginiana).

Human population pressure can directly affect the black-capped vireo. V. atricapillus is not a solitary species; a population consisting of five males and three females is the smallest breeding population I have ever found. Since each pair requires about 3-4 acres, it appears that a minimum of approximately 10-12 acres of suitable habitat is required

for the bird to become established in any one place. This is more than is generally given to native shrub growth near any human dwelling. Then too, there is increasing division of land holdings into ever smaller plots, each of which is treated differently, with the result that there may be few areas of suitable habitat large enough to support a population of this bird. In south central Texas, economy is forcing the change from large to small land holding at a rapid rate.

From north to south the plant species forming the habitat gradually change. In the northern and eastern parts of the bird's range (Oklahoma, and northern and eastern Texas) predominant tree species are the blackjack oak (Quercus marilandica), post oak (Q. stellata), and red cedar (Juniperus virginiana). In the central part (Texas hill country), they are live oak (Q. virginiana), Spanish oak (Q. texana), and mountain cedar (J. ashei). In the southwestern part, they are various scrub oaks (probably Q. undulata, Q. texana or gravesii, Q. mohriana, Q. grisea, Q. intricata, and others), yuccas (Yucca spp.), and cornaceous shrubs (Garrya spp.). Junipers are few in the habitat in Coahuila, Mexico. Various kinds of sumac (Rhus spp.) are important constituents of the overall habitat.

Woody plants now growing in parts of Comanche County, Kansas, believed to have been inhabited by the vireo some years ago, include the red cedar, American elm (Ulmus

americana), gray dogwood (Cornus drummondii), sumac (Rhus glabra, Rhus trilobata), poison ivy (Rhus toxicodendron), grape (Vitis sp.), woodbine (Parthenocissus quinquefolia), chinaberry (Sapindus drummondii), plum (Prunus spp.), currant (Ribes sp.), lead plant (Amorpha canescens), wafer ash (Ptelea trifoliata), and walnut (Juglans nigra). A few oaks (Q. stellata, Q. muhlenbergii, and Q. macrocarpa) occur in some ravines, but they are too large and too scattered to afford the type of growth preferred, and they probably have been so for more than a century. The bird probably occupied ravine slopes which were covered with small trees and shrubs of the species listed above. This type of habitat has been destroyed by drouth and cattle on all but the steepest and most shaded slopes.

The Kansas type habitat merges in northern Oklahoma with the cedar-oak (sometimes only oak) habitat so characteristic in that area and extends southward into northern Texas. The species and their relative importance are indicated in a detailed description of my study areas which follows. Mr. Geth Osborne and Mr. Edward C. Fritz describe the habitat on limestone slopes in Dallas County, Texas, as secondary growth consisting of the following species: red cedar, post oak, turkey oak, red oak, live oak, green ash, sumac (Rhus trilobata and R. glabra), deciduous holly (Ilex decidua), poison ivy (R. toxicodendron), black haw (Viburnum sp.), Forestiera sp., Prunus sp., woodbine (Parthenocissus quinquefolia), and

cactus (probably Opuntia sp.).

The Oklahoma-type habitat merges with that of the Edwards Plateau at about the latitude of Dallas as shown by the appearance of live oak. Relicts of the Edwards Plateau vegetation occur in the Arbuckle Mountains of southern Oklahoma. Post oak, blackjack oak, and cedar (the Oklahoma type habitat) occurs in the cross timbers as far south as Bastrop County, Texas, and are found in the central igneous region of Texas (Llano and surrounding counties).

The habitat on the Balcones Escarpment of the Edwards Plateau is described below. This type of habitat merges in Uvalde County with that occupied by the bird in the southwesternmost portions of its range. Trees and shrubs typical of the Edwards Plateau occur as far west as northeastern Terrell County (Webster, 1950). Species typical of the oak chaparral of Brewster County were found in Uvalde and Kinney Counties. Sotol (Dasylirion texanum) and Mexican persimmon (Diospyros texana), prominent plants in the habitat in Coahuila, Mexico, are found on the Balcones Escarpment. The western limits of the black-capped vireo appear to coincide with the eastern limits of the gray oak (Quercus grisea) and oneseed juniper (Juniperus monosperma), though I do not believe that this vegetation itself halts the vireo. The character of the vegetation does appear to limit the eastern spread of this bird, for the mesic forests of the eastern United States do not provide growth of the right size and

arrangement.

In southern Texas (Uvalde County), I found black-capped vireos occupying a habitat (burned over about seven years before) composed of the following species: Mexican persimmon, mescalbean (Sophora secundiflora), guajillo (Acacia berlandieri), buckthorn (Rhamnus caroliniana), evergreen sumac, leatherplant (Jatropha spathulata), algerita (Berberis trifoliata), and two chaparral oaks (Quercus spp.). A few larger trees of Spanish oaks, live oaks, and Mexican cedars (remnants of the dominant vegetation) were also present.

The habitat in northern Kinney County, Texas, appeared to be similar to that in the Glass Mountains north of Marathon. Cedar, scrub oak, live oak, mescalbean, and evergreen sumac were major components. A few small pinyon pines (Pinus cembroides) and gray oaks were noted. In parts of the Glass Mountains these last named species are common in the scrub growth. The vegetation of the Glass Mountains has been described by Sperry and Warnock (1941).

The habitat in northern Terrell County, Texas, has been described by Webster (1950). The vegetation of the slopes is like that the upper slopes of the Pecos River gorge exhibit, with the exception of cedars which are not found in the latter area. The persimmon-shin-oak association appears to have provided suitable habitat, as well as the cedar-shin-oak association in which it was found by Thornton

(1951). The cedar in the canyon floors is the habitat of the gray vireo, a very common species here. Terrell, Brewster, Kinney and southern Valverde counties are marginal areas for the black-capped vireo. In times when the climate is favorable, these areas provide a habitat, but in periods of drought they do not.

The habitat in Sierra Padilla, Coahuila, Mexico, appeared to be very similar to that described by Lesueur (1945) for isolated limestone Sierras (especially Sierra del Pino) in northeastern Chihuahua. According to Lesueur the lowest oaks appear at 5600 feet, and grow in dense mottes about one meter high. The drooping juniper (J. flaccida) begins at 5800 feet. From 6200 to 6600 feet a dwarf form of Quercus undulata is common and with Ceanothus greggii, Garrya obovata, Fendlera linearis, Juniperus flaccida forms an impassable mat. In addition to the species mentioned by Lesueur, I noted (in the area occupied by black-capped vireo) Acacia berlandieri, Cercis sp., Dasylirion texanum, Yucca sp., Rhus virens, Mimosa sp., Quercus gravesii, and Quercus grisea. A few large pines grew on isolated ridges in this range, but I saw no pinyon pines. In this area Vireo atricapillus was the common (and almost only) vireo. I saw only one other vireo, a Hutton's vireo.

The habitat in the Sierra Madera in Coahuila was similar to that of Sierra Padilla, but I saw no redbud (Cercis sp.) there, and a fine pine forest covered the higher

slopes. This range reminded me of the Chisos Mountains, and of the Sierra del Carmen, as described by Miller (1955). Black-capped vireos were found only on dry, limestone hillsides where there were thick mats of vegetation about three to five feet in height. In this growth, Quercus undulata, and Rhus virens were the most common woody plants. Also noted were: Nolina sp., Yucca sp., Dasylirion texanum, Juniperus flaccida, Prunus sp., Rhamnus sp., Garrya sp., Lonicera sp., Bumelia sp., and Arbutus texana. This shrub growth was most luxuriant on slopes facing north and east. That which I examined on other slopes appeared to be half-dead from the drought. There was no surface water in this range. The closest water, a small reservoir which supplied a few families, was two miles from the Sierra's base. The same situation existed at Sierra Padilla.

Detailed Description of the Oklahoma and Texas Study Areas

In an effort to understand the breeding habitat requirements, I made a count of the woody plants and estimated the size of trees in quadrats encircling most of the nests. These quadrats measured 50 feet on a side and were laid out by means of cord measured to that length. Since most of the trees were not over 15 feet tall, an estimate of their diameter was made at a height of two feet above the ground (instead of DBH). In the case of Juniperus ashei which branches near its base, each limb or trunk was considered separately

to make possible comparison with Juniperus virginiana. Data from 54 quadrats in Oklahoma and 35 in Texas are presented. Data from one quadrat in Coahuila are also presented, but plants collected in this area have not been finally identified. Frequency is considered in Tables XIII and XIV.

In Tables XV and XVI, data are presented on the size and number of trees. I believe that these data are important because they further reveal the nature of the vegetation in which the black-capped vireo breeds. The woody plants are principally small, many-branched trees and shrubs that provide good cover at near the ground. Some larger trees grow in the habitat. This unevenness of vegetation is characteristic. I have never found the black-capped vireo in oak shinnery cover of uniform height. The species prefers mottes which because of their distribution in small thickets or clumps with spaces between give the landscape a "woolly" aspect when viewed from a distance.

The total number of shrubs and trees per quadrat varied from 33 to 328 (average 122.3) in the Oklahoma study area. In Texas, the number ranged from 61 to 568 (average 246). In one quadrat in Mexico (Sierra Padilla) the number was 715.

The vireo chooses a habitat in which there is a considerable variety of woody plants. No fewer than 27 species of such plants grew in the Oklahoma quadrats. The average number of species per quadrat was 7.8 (maximum number, 16;

TABLE XIII

FREQUENCY (IN PERCENT) OF WOODY PLANTS IN OKLAHOMA QUADRATS

Species	Fifty-four Quadrats (52 in Caddo Co., 1 in Dewey Co., 1 in Major Co.)	Fifty-two Caddo Co. Quadrats
Quercus marilandica	98.1	98.0
Quercus stellata	88.8	90.3
Juniperus virginiana	90.7	92.3
Celtis reticulata	72.2	73.0
Opuntia sp.	64.8	67.3
Rhus glabra	64.8	63.4
Symphoricarpos orbiculatus	59.2	59.6
Aesculus glabra	46.2	44.2
Rhus toxicodendron	29.6	30.7
Parthenocissus quinquefolia	27.7	28.8
Cercis canadensis	20.3	21.1
Quercus muhlenbergii	20.3	19.2
Bumelia lanuginosa	18.5	19.2
Prunus angustifolia	18.5	15.3
Rhus trilobata	16.6	15.3
Ulmus americana	9.2	9.6
Cornus drummondii	9.2	7.6
Juglans nigra	5.5	5.7
Smilax bona-nox	5.5	5.7
Amorpha canescens	3.7	3.8
Yucca glauca	3.7	3.8
Prunus mexicana	1.8	1.9
Morus rubra	1.8	1.9
Ptelea trifoliata	1.8	1.9
Forestiera pubescens	1.8	1.9
Cissus incisa	1.8	1.9
Vitis sp.	1.8	1.9

TABLE XIV

FREQUENCY (IN PERCENT) OF WOODY PLANTS IN TEXAS QUADRATS

Species	Thirty-five Quadrats in Hays and Comal Counties		
	All 35 Quadrats	Fourteen Quadrats in Recently Burned Area	Twenty-one Hill Country Quadrats
Quercus virginiana	94.2	100.00	90.4
Juniperus ashei	80.0	64.2	90.4
Diospyros texana	74.2	85.7	66.6
Rhus virens	71.4	35.7	95.2
Quercus texana	60.0	92.8	38.0
Berberis (both trifoliata and swazeyi)	57.1	42.8	66.6
Vitis cinerea	45.7	78.5	23.8
Rhus lanceolata	42.8	92.8	9.5
Yucca rupicola	42.8	64.2	28.5
Cercis reniformis	31.4	78.5	0.0
Smilax bona-nox	31.4	35.7	28.5
Mimosa borealis	37.1	47.1	23.8
Bumelia sp.	28.5	35.7	23.8
Chilopsis linearis	25.7	57.1	4.7
Rhus toxicodendron	25.7	50.0	9.5
Opuntia sp.	20.0	42.8	4.7
Quercus breviloba	11.4	7.1	14.2
Prunus serotina	11.4		
Forestiera sp.	11.4	7.1	14.2
Rhus trilobata	11.4	14.2	9.5
Amorpha sp.	11.4	14.2	9.5
Ungnadia speciosa	8.5	21.4	0.0
Garrya lindheimeri	5.7	14.2	0.0
Ulmus crassifolia	5.7	0.0	9.5
Lantana horrida	5.7	14.2	0.0
Cissus sp.	2.8	7.1	0.0
Melia azedarach	2.8	7.1	0.0
Cocculus carolinus	2.8	7.1	0.0
Ptelea trifoliata	2.8	0.0	4.7
Lonicera sp.	2.8	7.1	0.0
Celtis sp.	2.8	7.1	0.0
Nolina sp.	2.8	7.1	0.0
Prunus mexicana	2.8		

TABLE XV

NUMBER AND SIZE OF LIVING TREES IN FIFTY-FOUR OKLAHOMA QUADRATS
(1954-55 DATA)

Species	Diameter in Inches at Two Feet												
	Under 1	1	2	3	4	5	6	7	8	9	10	Over 10	Total No.
Quercus marilandica	688	869	411	303	168	65	15	5	4	1	3		2532
Quercus stellata	446	550	210	135	70	16	3	3	1		1	4	1439
Juniperus virginiana	41	28	28	47	48	37	31	3	7	8	3		281
Celtis reticulata	130	96	37	9	1		1			1			275
Aesculus glabra	28	90	19	11	2								150
Quercus muhlenbergii	32	20	7	8	10	1	1						81
Cercis canadensis	17	21	6	1	2	1							48
Bumelia lanuginosa	4	2	2	3		6		1					18
Ulmus americana	10	3			1			1	1				16
Juglans nigra					1						1		2
Prunus mexicana					1								1
All Species	1396	1681	720	517	304	126	51	13	13	10	8	4	4843
Dead Trees	7	86	83	52	30	15	6				1		280 or 5.7%

TABLE XVI

NUMBER AND SIZE OF LIVING TREES IN THIRTY-FIVE TEXAS QUADRATS IN HAYS & COMAL COUNTIES (1956 DATA)

Species	Diameter in Inches at Two Feet												
	Under 1	1	2	3	4	5	6	7	8	9	10	Over 10	Total No.
Quercus virginiana	751	350	187	107	55	37	27	13	3			3	1533
Juniperus ashei	421	466	232	111	43	16	1	1					1291
Quercus texana	196	112	36	25	17	9	1	2				2	400
Cercis reniformis	61	43											104
Quercus breviloba	72	15	2	4	1								94
Bumelia sp.	52	4	1	1	2								60
Prunus serotina	3	2	3										8
Ulmus crassifolia	1			1		1	3						6
Prunus mexicana	2	3	1										6
Celtis sp.	1												1
All Species	1555	990	458	249	118	63	32	16	3			5	3503

minimum, 4). In all the Texas quadrats, a total of 33 species grew (average number of species per quadrat, 8.8; maximum, 19; minimum, 3). In two quadrats on an ungrazed burn area (not burned recently) the average number was 6.9 (maximum, 13; minimum, 3). In one quadrat in Mexico (Sierra Padilla), 14 species of woody plants were found. In the Texas quadrats in which only two or three species of woody plants were found, the cover was provided by cedar with evergreen sumac understory, live oak with cedar understory, or live oak with evergreen sumac understory. In the two Oklahoma quadrats in which only four species of woody plants were found, the cover was provided by blackjack oak and cedar, and blackjack oak, post oak, and cedar.

One other feature of the habitat was considered—the age of the trees. As Beecher (1942) has stated, an animal population can be no more stable than the plant community in which it lives. In case of the black-capped vireo, the habitat must remain suitable for a certain minimum of time, just as there must be a certain minimal area of suitable habitat for a population to establish and maintain itself. Furthermore, an area in which the vegetation remains suitable for long periods provides more available habitat than an area in which the plants grow faster. If the vegetation in a certain locality remains suitable for 30 years, the area provides five times as much habitat as one in which the woods becomes too large in six years.

In the Oklahoma study area, red cedars 9-10 feet high and with basal diameters of 2 to 3 inches were estimated, by counting growth rings, to be 18 to 19 years old. Oaks of this size were found to be 12 to 38 years old. A buckeye shrub (Aesculus glabra) 6 feet high with basal diameter of 2 inches was estimated to be 13 years old. Sumac (Rhus glabra) 5 feet high, with basal diameter of 5/8 inch was 5 to 6 years old, this plant having grown since the last burn in the area seven years previously. Two oaks (Q. undulata) from Sierra Madera with basal diameters of one inch had 19 growth rings. On burns within the main part of the vireo's range (Texas and Oklahoma), shrub growth can attain a height of two to three feet in three years (if conditions are usual). From this stage, growth is slow, probably because of the shallowness of the soil which limits the moisture available to plants. Black-capped vireos are most often found on steep slopes, simply because the woody growth remains a suitable size for longer periods than it does in areas where there is more soil. Rugged terrain provides many micro-climates and varied edaphic conditions so that the vegetation grows irregularly, forming clumps. Flat land tends to grow forest or prairie depending on climate and soil. Only in a very limited area (prairie-forest ecotone) can vacillations in climate produce dwarf forests on flat land, and such shinnery, because of the evenness of its height and arrangement, is seldom attractive to black-capped vireos. Instead the bird seeks

ravines which can provide the conditions mentioned above. More habitat may be produced by the vacillations in climate, provided these are not severe.

The vegetation must be distributed over certain area (a spatial requirement), not arranged linearly in rows or strips as with roadside shrubbery. The black-capped vireo sometimes nests on the roadside, but only when a suitable area adjoins the roadside. The species does not utilize roadside edge as does the Bell's vireo.

Vegetation of the Wintering Habitat

The wintering habitat (see Figures 13-16) is difficult to describe. The requirements of the species apparently are less strict in the non-breeding season than in the breeding, and so there is a wider range of vegetational types in the winter habitat than in the summer. In southern Sinaloa (near Concordia, which lies just east of Mazatlan, in the first foothills of the Sierra Madre Occidental), the winter habitat was arid scrub 2-10 feet in height. Prominent among many woody species were Ardesia revoluta, Bursera sp., Mimosa sp., and Ipomoea intrapilosa. Large cacti (columnar cereus) were interspersed throughout the woodland. When I was there (December) few of the trees had leaves, though some were flowering, especially Ipomoea. The aspect was not unlike the breeding habitat in Texas at about arrival time.

The habitat in Nayarit (near Las Varas on the coast

west of Compostela) the winter habitat was more mesic and luxuriant than that of Sinaloa. Here the bird chose cut-over and secondary growths that were composed of an incredible mixture of woody plants, palmettos, palms, cacti of various types, and mimosa. Especially prevalent were Combretum farinosum, and the large leaved shrub, Bixa orellana. Thickets of the latter appeared to be especially favored by the black-capped vireos. This habitat seemed different (except for its shrubby nature) from any in which I had found the vireo, and I suspect it is a secondary habitat which has become available only in the wake of cutting and clearing.

Climate

Climatographic studies of the breeding area should provide indices of conditions most suitable to the physiological requirements of a bird species, since the young have less tolerance than adults; the critical period is the nesting period; extremes at other times may not affect the species; local disturbances can dislodge a species from marginal habitat; habitat that is suitable in "good" seasons can become intolerable in "bad"; species having a narrow range of tolerance do not readily adapt to new environments (Twomey, 1936).

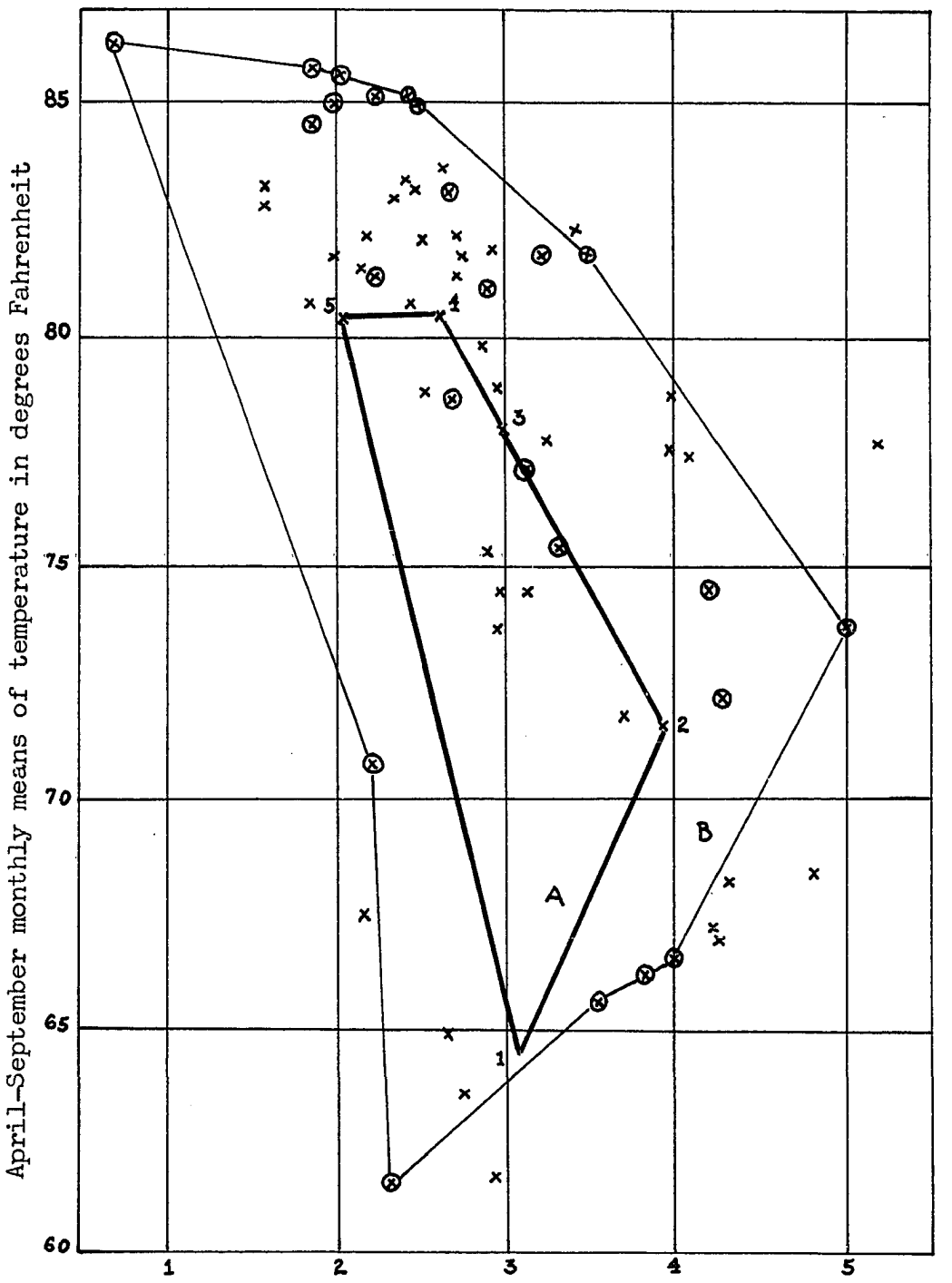
To ascertain how temperature and precipitation might influence the distribution of this vireo, climatographs were prepared using data supplied by the United States and Mexican

Weather Bureaus (1956 Climatological Data for U.S., and Atlas Climatologico de Mexico 1939). Long term monthly means for April, May, June, July, and August were plotted on the graphs as April 1, June 2, etc. Climatographs were prepared for the wintering area also, using monthly means (the average of 14 years, 1921-1935) for September through March, numbering the months on these maps as September 1, October 2, etc.

In Graph VI, Climatograph A, lying within B, represents data for Kerrville, Texas. This locality was chosen because the black-capped vireo has long occupied it continuously and successfully. It lies in the central portion of the breeding range, and since its weather data appears to be close to the mean of all areas in which the bird breeds, it probably represents the optimum conditions. Climatograph B, which encircles A, is based on localities now occupied by the vireo: Anadarko, Oklahoma; Boerne, Uvalde, Dallas, Waco, and Austin, Texas. Encircled points are from these localities. Other points are from localities in which the vireo has been known to occur (and breed): Cimarron, Jetmore, Medicine Lodge, and Winfield, Kansas; Apache, Tulsa, and Oklahoma City, Oklahoma; and Junction and San Angelo, Texas. April temperatures were omitted for Jetmore, Cimarron, Medicine Lodge, and Winfield, Kansas, and for Tulsa and Oklahoma City, Oklahoma. The bird does not arrive until late April in these places, so they may be disregarded. Climatograph B represents the limits of rainfall and temperature in localities in

GRAPH VI

TEMPERATURE AND PRECIPITATION
IN BREEDING HABITAT



which the vireo regularly breeds. Points outside of B are from localities occupied when climatic variation alters them to fall within the bird's habitat requirements.

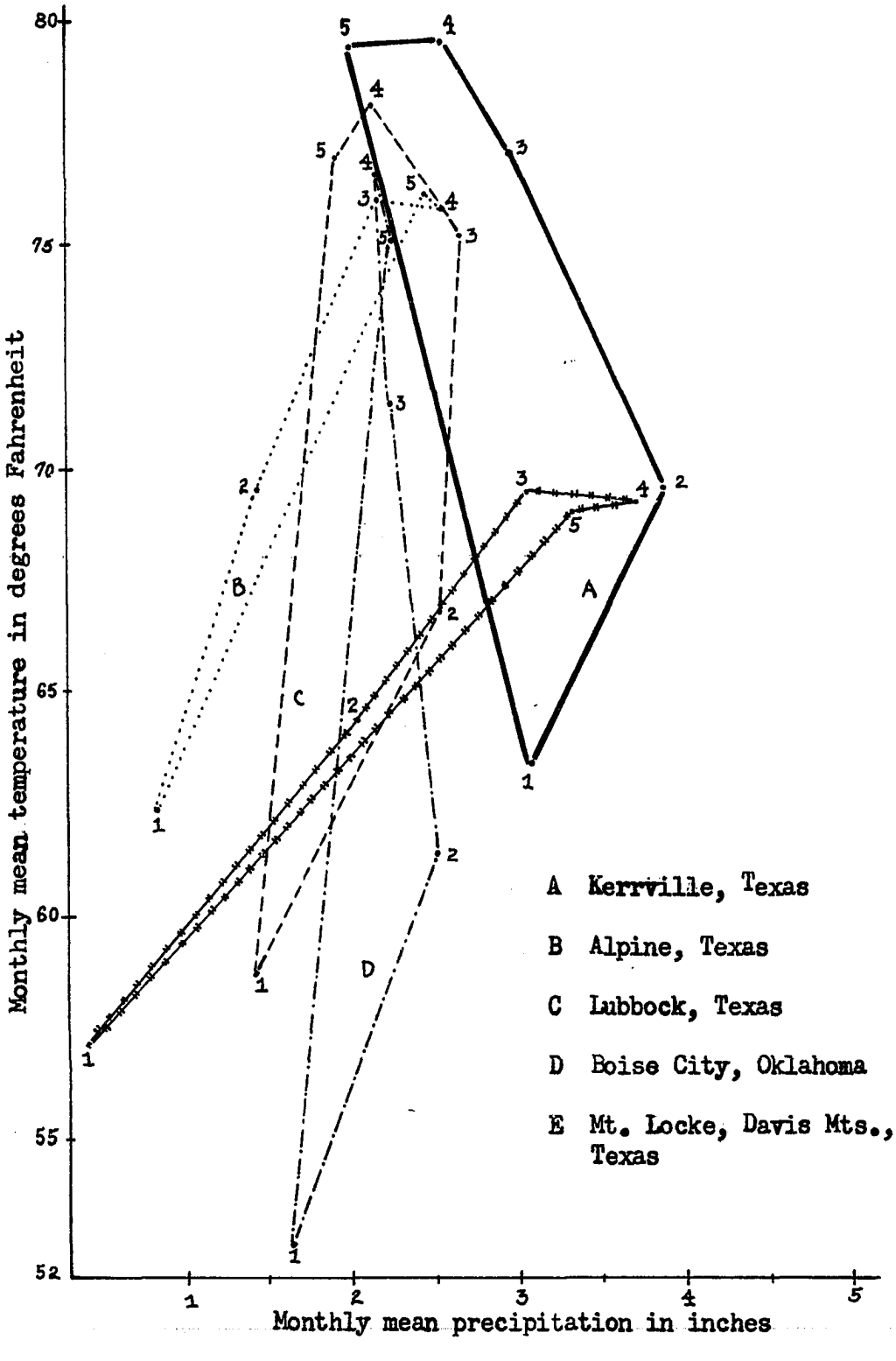
Graph VII depicts rainfall and temperature at Kerrville, Texas, and at several localities just west of the western limits of the breeding area. The Davis Mountains in Jeff Davis County, Texas, and the Glass Mountains near Alpine, in northern Brewster County, Texas, have shrubby habitat which appeared to be suitable for breeding, but I saw no birds there in 1955 and 1956. Graph VII suggests that western limits of breeding are determined by coolness and dryness. This picture is based on long term means. In some periods the climate may allow the vireo to become established, but in general it is unfavorable. Here climate itself, rather than vegetation, appears to be the limiting factor.

Graph VIII compares precipitation and temperature of three localities to the north and east of the bird's range with that at Kerrville. Lack of suitable habitat, rather than climate, limits the vireo in this direction. Greater amount of precipitation indirectly affects the distribution because the vegetation grows too rapidly and becomes too large to provide acceptable habitat.

At present, drought conditions have brought about a reduction in the breeding range, especially in the north and west. In 1885-1900, the vireo bred in southern Kansas and western Texas (San Angelo). Kincer has depicted a gradual

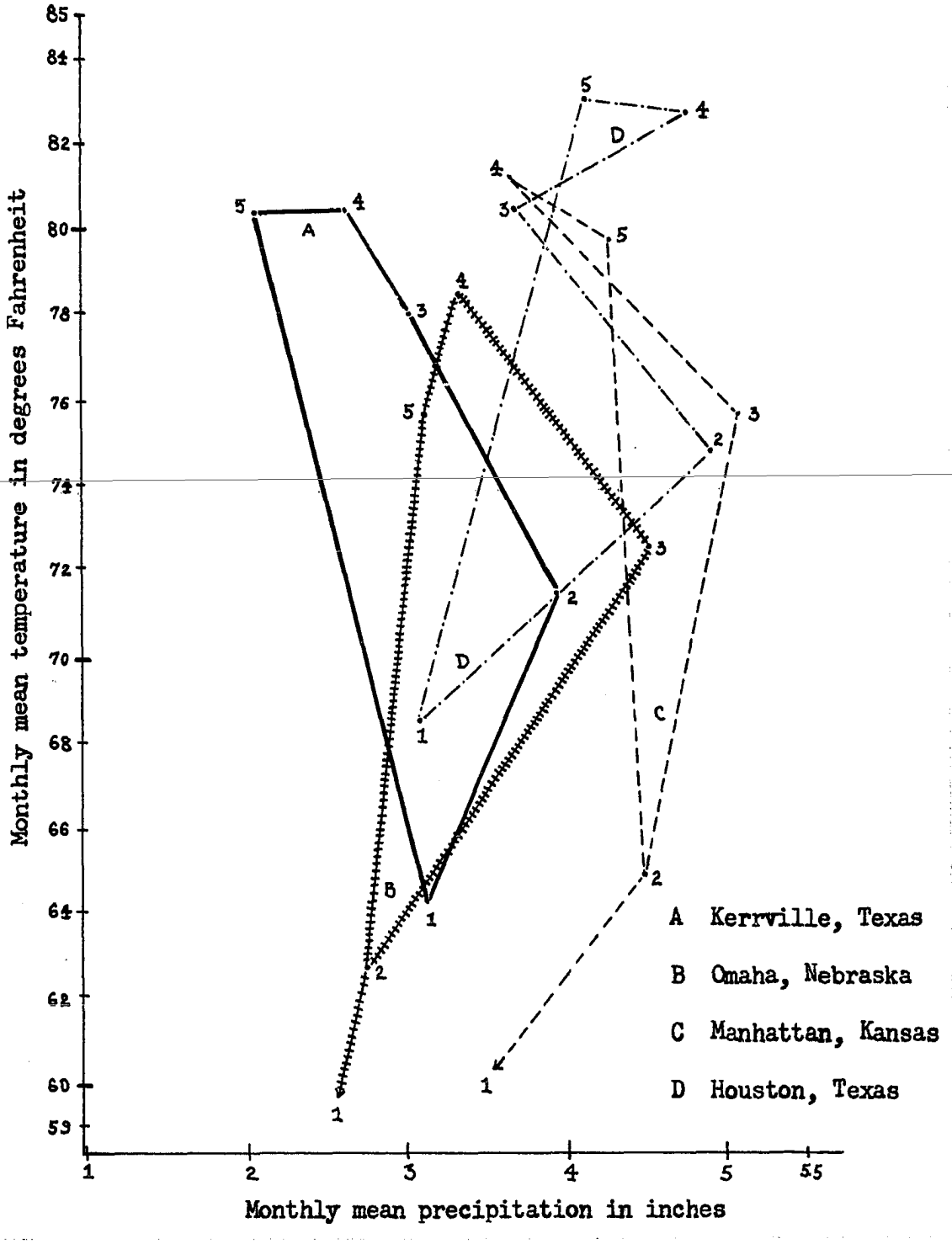
GRAPH VII

TEMPERATURE AND PRECIPITATION IN WESTERN TEXAS AND WESTERN OKLAHOMA



GRAPH VIII

TEMPERATURE AND PRECIPITATION IN LOCALITIES
NORTH AND EAST OF THE BREEDING AREA
AND THOSE AT KERRVILLE, TEXAS



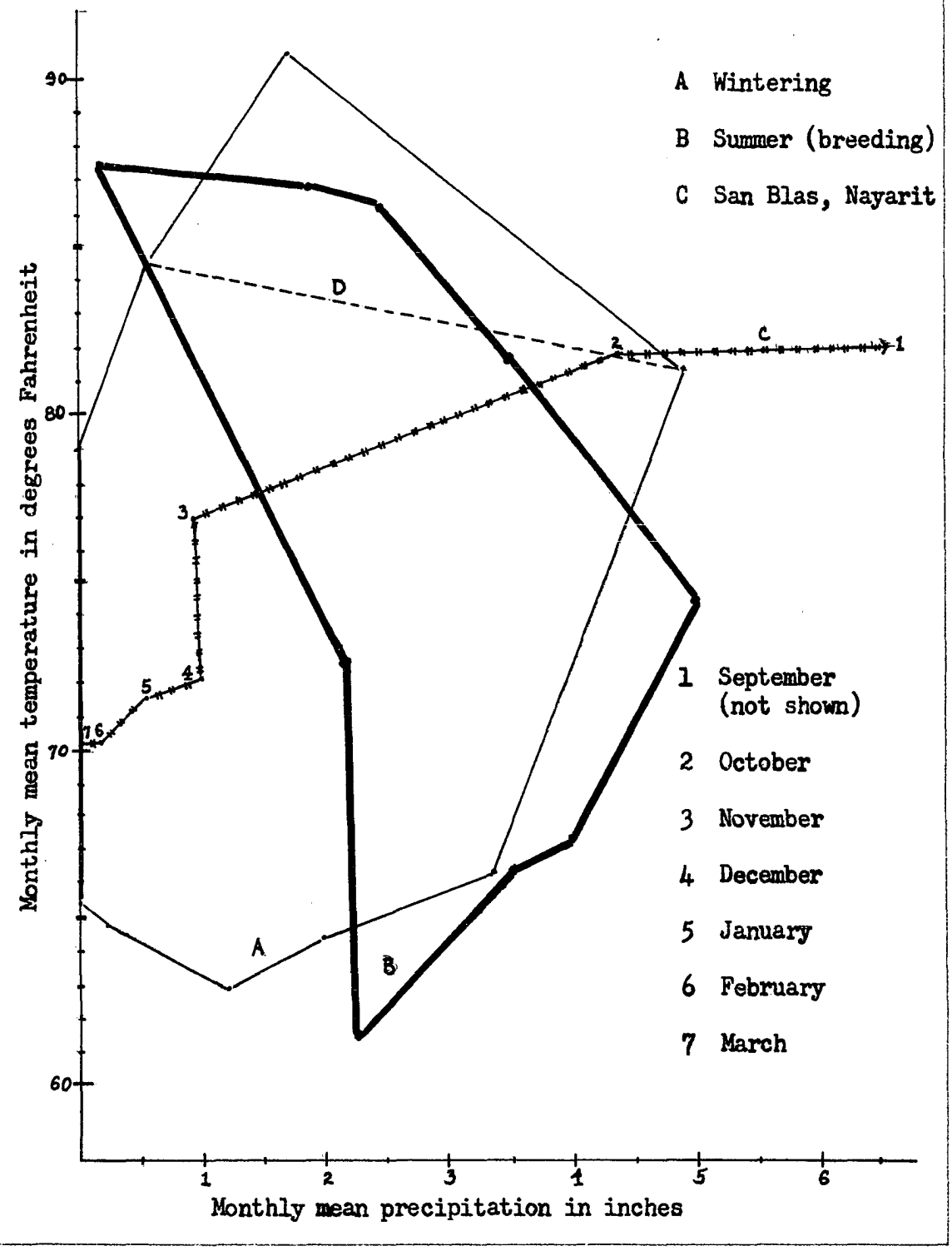
decrease in precipitation and an increase in temperatures since 1910 (Tannehill, 1947). Between 1850 and 1910 rainfall was greater and temperatures cooler (Bowman, 1935). But though the vireo occupies a zone of transition between humid and dry climates, a zone in which fluccuation is characteristic (Kendall, 1935), long term trends toward aridity appear to have a pronounced effect on its distribution.

Graph IX depicts September-to-March temperature and precipitation on the wintering grounds. Line C represents conditions (monthly means numbered) at San Blas, Nayarit, Mexico, a locality having intermediate position and climate. Enclosure A represents the range of conditions from Ciudad Obregon, Sonora, to Acapulco, Guerrero, Mexico, and from sea level to 3011 feet (Tepic, Nayarit). Enclosure B (as in Graph VI) represents the range of conditions on the breeding grounds in Texas and Oklahoma from April to September. Line D indicates the limits of most of the localities of the wintering grounds (the larger enclosure includes Ciudad Obregon, Sonora). Localities included in preparing A are: Ciudad Obregon, Sonora; Mocorito, Culiacan, and Mazatlan, Sinaloa; Acaponeta, Tepic, and San Blas, Nayarit; Manzanillo, Colima; and Acapulco, Guerrero.

During most of the winter the wintering grounds are much more arid than the breeding grounds. Only in September and October is there as much or more rainfall than in the breeding area. This aridity can be endured because it

GRAPH IX

TEMPERATURE AND PRECIPITATION OF
WINTERING AND BREEDING HABITATS



follows a rainy season, thus being quite different than if it were a drought or desert condition. On the breeding grounds it would affect the vegetation because a large portion of the annual precipitation occurs during spring and summer. Monthly means of rainfall in the area inhabited vary from 0.0 to 6 (possibly 10) inches. Moisture is frequently provided in the form of fog along the coastal lowlands of Mexico.

The temperature limits of the breeding and wintering grounds are about the same, monthly means falling between 60° and 87° F. When I was in Mexico in late December 1956, I recorded the maximum temperatures at 85-98° F. near Concordia, Sinaloa, and at 86° F. at Las Varas, Nayarit. Daily minimums were 58-62° F. near Concordia, and 51-54° F. at Las Varas. The cooler night temperatures at the lower elevation (Las Varas) were brought about by coastal fogs. These recordings were taken in the field at the places I saw black-capped vireos wintering. The U.S. Weather Bureau provided the following data:

Locality	Winter Temperature			
	Extreme Highest		Extreme Lowest	
Acapulco	97	(Oct.)	60	(Feb.)
Campeche	95	(Mar.)	54	(Feb.)
Mazatlan	92.1	(Sept.)	52.2	(Jan., Feb.)
Culiacan	104	(Sept.)	38	(Jan.)

The northern limits of the wintering grounds are probably set by low extremes of temperature. The bird appears to prefer temperatures well above freezing, though it can withstand brief cold spells. It is relatively heat tolerant.

The wintering and breeding grounds do not have greatly differing climates. The more variable factor, rainfall, has broader limits in the winter. The black-capped vireo has a narrow range of climatic tolerance, and its distribution is relatively limited, suggesting that it does not adapt readily to new environment.

I have witnessed hailstorms, rainstorms, dust storms, and high winds while observing the black-capped vireos, but have never seen any losses of eggs, young, or adults because of unusual weather. Bunker (1910) reports loss of eggs from nests following a severe storm.

CHAPTER XI

DISCUSSION

The black-capped vireo is distinctive, as a species of the genus Vireo, in that its plumage color exhibits pronounced sexual dimorphism, its eggs are pure white, and its song is composed of extremely variable phrases. A winter head molt, which may also be distinctive, may be an aspect of sexual dimorphism. The species appears to be not primitive, but highly specialized. It may be of recent or of very ancient origin.

No factor was found in the life cycle that could account for its limited numbers. Its habits are similar to those of other virecs. Its nesting success is low compared to that of other passerines, but not lower than that of a closely related, more widely distributed species of vireo, Vireo bellii. The black-capped vireo suffers large reproductive losses because of cowbird parasitism, but so does Bell's vireo. The black-capped vireo's low reproductive success is probably compensated for by the survival rate and longevity of adults. The species appears to be as long-lived as certain more widely distributed forms (Hann, 1948; Nice,

1937).

Vireo atricapillus appears to be unusually free of ectoparasites and disease. Loss during breeding season may have amounted to one adult from 150 birds in three seasons' observations. Few, if any, predators take adult vireos.

Vireo atricapillus does not appear to be restricted by diet. Food found in the stomachs of 11 specimens was similar in type and amount to that found in stomachs of the Red-eyed Vireo (Chapin, 1925). Interchange of young black-capped and Bell's vireos showed that each of these could subsist as nestlings and fledglings on the food of the other. A captive fledgling atricapillus throve on a variety of insects.

Presence of surface water does not account for the black-capped vireo's localized distribution. The bird lives in some situations where no water, other than that present in its food or resultant from occasional precipitation, is available.

The habitat provides good shelter and cover. No loss of any kind resulted from rain, wind, hail, or severe dust storms that occurred during my observations.

The bird is limited by a narrow range of temperature tolerance. It does not occur in areas in which the temperature falls below a certain point. This probably explains why the species has not spread northward or into the mountains.

The size and arrangement of vegetation appears to be

important. The type of woody plants is important. Throughout the bird's breeding range several different plant (species) associations are found, but these associations intergrade with each other, and their members may be considered as ecological counterparts. The type of vegetation occupied occurs very locally throughout the area in which the climate is suitable, perhaps explaining the bird's localized distribution. It has occupied all the available habitat and apparently does not adapt to other habitats.

CHAPTER XII

SUMMARY

1. Vireo atricapillus migrates northward in spring, arriving in the southern part of the breeding grounds in March, in the northern part, in late April.
2. The male establishes a territory of two and one-half to four and one-half acres by song and pouncing. All activities are carried out on this territory. Individual birds return to the same territories year after year.
3. Mates may be changed between broods or between seasons, but usually a pair remains together for a season. The female is courted by song and display.
4. Nests are placed in crotches of limbs one to four feet above the ground. Oaks are usually chosen. There is a tendency for vireos to re-use nest sites season after season.
5. The nest is typically vireonine. It is built of materials available nearby, and both male and female participate in nest-building. Construction may take as little as four days or as much as 16 days.
6. Laying occurs at about 6:00 a.m. (during June, in

Oklahoma) on consecutive days. The peak of laying is in May in Texas and in June in Oklahoma.

7. A clutch consists of three or four eggs. The eggs are white, immaculate, and average approximately 17.6 x 13.1 mm. They weigh about 1.5 grams.
8. Incubation begins after the laying of the second or third egg. In general the parent birds incubate alternately throughout the day. The female incubates at night. The incubation period varies from 14 to 17 days.
9. At hatching, the chick is completely naked and blind, and weighs about one gram. It gains about a gram a day until it weighs seven or eight grams. Its feathers unsheath on the eighth day. It leaves the nest at 10 to 12 days. The postjuvenal molt begins at the age of two weeks. Forty-four days after leaving the nest, one young bird was independent of its parent.
10. The young in the nest are cared for by both male and female adults. The female does all the brooding. The male brings about three-fourths of their food to the young. Fledglings are cared for by both parents for four to seven days, then the female begins another nesting. She either does all the incubation and cares for the young of the second brood or gets another male to help her, her first mate being occupied with the care of the fledglings.
11. The young are fed 0.8 to 2.6 times an hour. As the young grow, the number of trips the adults make to bring food

to them remains the same, but larger items are brought. One cowbird chick requires as much food as four vireo chicks.

12. A black-capped vireo egg placed in the nest of a Bell's vireo (Vireo bellii) hatched and the young bird was reared by this foster parent. Likewise, a Bell's vireo was reared by a black-capped vireo.

13. Of 243 eggs, 43 (17.6%) were successful to the stage of nest-leaving. Of 75 nests, 15 (20%) were successful in producing one fledgling. A survey of pairs was made late in the breeding season. Of 77 pairs, 45 were successful in fledging at least one young bird.

14. The greatest losses in eggs and young were caused by cowbird activity. Ninety-seven eggs (72.3% of those lost), and 25 (29.7% of the viable chicks) chicks were lost because of cowbirds. The Bell's vireo appears to sustain such losses also.

15. Fall migration begins in August. The earliest known arrival on the wintering grounds is August 27th. No black-capped vireos have been seen on the breeding grounds after September.

16. Between 50 and 60 per cent of the breeding birds were new to the Oklahoma study area each season. Between 75 and 80 per cent of the banded males returned for a second season, but only 33.3% to 41.6% of the females returned. The difference may be accounted for by the elusiveness of

the female and by failure of the female to return to the same area. Twenty-nine per cent of the banded birds returned for a third season (41.6% of the males, 16.6% of the females). One pair (8.6%) of 23 birds trapped in 1955 were birds breeding for the first time.

17. The sex ratio varied from 100 (males):100 to 131:100. A few males did not find mates during some seasons.

18. The habits of this vireo are similar to those of other vireos. This species is very active, roosts solitarily, and was observed to bathe in water. Its song is the most complicated within the genus Vireo. It has at least four different songs and gives several other sounds.

19. The food found in stomachs of eleven specimens was similar to that found in stomachs of other vireos by Chapin. The bulk of the food is composed of larvae of Lepidoptera and of small Coleoptera. In fall and winter, some seeds are eaten. The bird can apparently live in regions where there is no surface water.

20. No ectoparasites were found on any vireo or in any of their nests. No birds appeared to be diseased.

21. The age and sex of an individual are indicated by plumage. Northern adult males are slightly larger than southern adult males (a size cline). Males are larger than females. Older birds tend to be larger than younger birds. The juvenal plumage and the molts are described. A peculiar molt on the head occurs in November, so that

all males have darker heads than females by breeding season.

22. Vireo atricapillus breeds locally from north central Oklahoma, through central Texas, to north central Mexico (Coahuila). It winters on the west coast of Mexico from southern Sonora to Guerrero. In the breeding area it is usually found at elevations of 1,000-2,000 feet, but may occur at 5,500-6,000 feet in the southern part of its range. In winter it occurs at elevations from sea level to about 3,000 feet.

23. The breeding range at present is smaller than it was around 1900. Long term trends toward higher temperatures and less precipitation may account for a reduction in the habitat at the western and northern edges of the breeding range.

24. A list of other vertebrates found on territories of black-capped vireos is given. The ecological relationships of V. bellii, V. griseus, V. huttoni, and V. vicinior are briefly discussed.

25. Vegetation of the habitat was studied in two areas in which the species is successful, and in areas at the edge of the bird's range. The species prefers scrub-oak growth of irregular height and distribution. The habitat must cover a rectangular, rather than a linear area. Eroded slopes often provide edaphic conditions which favor such habitat.

26. Monthly means of temperature in the areas occupied by the bird (both in summer and winter) were between 63° and 87° F. Extreme lows of temperature were well above freezing (37° F.). Monthly means of precipitation were between zero and five inches. Precipitation is important indirectly because of its effect on vegetation.
27. The black-capped vireo appears to be limited in its distribution by rigid requirements of vegetative and climatic factors. It does not adapt to modified conditions and therefore becomes very limited in its distribution.

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APPENDICES

APPENDIX I

List of Abbreviations Used for Museums and Natural History Collections:

AMNH	American Museum of Natural History, New York, N.Y.
BM	British Museum (Natural History), London, England.
BU	Strecker Museum at Baylor University, Waco, Texas.
CAS	Chicago Academy of Sciences, Chicago, Ill.
CNHM	Chicago Natural History Museum, Chicago, Ill.
CM	Carnegie Museum, Pittsburgh, Pa.
CU	Cornell University (collection), Ithaca, N.Y.
DMNH	Dallas Museum of Natural History, Dallas, Texas.
HM	Hastings Museum, Hastings, Nebraska.
KSHS	Kansas State Historical Society (collection), Topeka, Kansas.
KU	Museum of Natural History, University of Kansas, Lawrence, Kansas.
LACM	Los Angeles County Museum, Los Angeles, Cal.
LSU	Museum of Natural Science, Louisiana State University, Baton Rouge, Louisiana.
MC:OC	Moore Collection at Occidental College, Los Angeles, Cal.
MMNH	Minnesota Museum of Natural History, University of Minnesota, Minneapolis, Minn.
MT	Museum of Northern Arizona, Flagstaff, Arizona.

MVZ	Museum of Vertebrate Zoology, University of California, Berkley, Cal.
OU	Museum of Zoology, University of Oklahoma, Norman, Okla.
PAC	Academy of Natural Sciences, Philadelphia, Pa.
PM	Peabody Museum, Salem, Mass.
PMZ	Princeton Museum of Zoology, Princeton University, Princeton, N.J.
TU	University of Texas (collection), Austin, Texas.
UMMZ	University of Michigan Museum of Zoology, Ann Arbor, Michigan.
USNM	U. S. National Museum (Smithsonian Institute), Washington, D. C.
YPM	Yale Peabody Museum, Yale University, New Haven, Conn.

APPENDIX II

List of Specimen Skins Examined:

Locality	Museum No.	Age	Sex	Collector
Kansas				
Comanche Co.	KU 2472	1st yr.	♂	Goss
Oklahoma				
Blaine Co.	OU 2752	Adult	♂	C. D. Bunker
Blaine Co.	OU 2792		♂	C. D. Bunker
Blaine Co.	OU 2881	Adult	♂	C. D. Bunker
Blaine Co.	OU 2886	Adult	♂	C. D. Bunker
Blaine Co.	OU 2887	Adult	♂	C. D. Bunker
Blaine Co.	OU 2895	Adult	♂	C. D. Bunker
Blaine Co.	OU 2897	1st yr.	♂	C. D. Bunker
Blaine Co.	OU 2901	Adult	♂	C. D. Bunker
Blaine Co.	OU 2902	Adult	♂	C. D. Bunker
Blaine Co.	OU 2905	Adult	♂	C. D. Bunker
Blaine Co.	OU 3107	Adult	♂	C. D. Bunker
Blaine Co.	USNM 300109	Adult	♂	C. D. Bunker
Blaine Co.	KU 20748	?	♂	Maye Leonard

Locality	Museum Number	Age	Sex	Collector
Blaine Co.	OU 2882	?	♀	C. D. Bunker
_____	OU 2894			C. D. Bunker
Blaine Co.	OU 2904	?	♀	C. D. Bunker
Blaine Co.	USNM 300110	?	♀	C. D. Bunker
Caddo Co.	OU 745	Adult	♂	G. M. Sutton
Caddo Co.	OU 1415	Adult	♂	G. M. Sutton
Caddo Co.		Adult	♂	R. R. Graber 2846
Caddo Co.	OU _____	Juv.	♀	R. R. Graber 2206
Caddo Co.		Juv.	♀	J. W. Graber 2286
Caddo Co.		1st W.	♀	R. R. Graber
Comanche Co.	USNM 341271	1st Yr.	♂	T. D. Burleigh
Comanche Co.	UMMZ _____	Adult	♂	T. D. Burleigh 6109
Dewey Co.	OU 2082	1st Yr.	♂	G. M. Sutton
Dewey Co.	OU 2083		♀	G. M. Sutton
Murray Co.	OU _____	Adult	♂	G. M. Sutton 7267
Murray Co.	OU _____	Adult	♂	G. M. Sutton 7273
Murray Co.	OU _____	Adult	♂	G. M. Sutton 7274
Murray Co.	OU _____	Adult	♂	K. W. Haller 311
Murray Co.	OU _____		♀	G. M. Sutton 7268
Murray Co.	OU _____		♀	G. M. Sutton 7269

Locality	Museum Number	Age	Sex	Collector
Texas				
Bexar Co.	USNM 152362	1st yr.	♂	H. P. Attwater
Bexar Co.	USNM 152363	Adult	♂	
Bexar Co.	AMNH 84976	Adult	♂	H. P. Attwater
Cooke Co.	UMMZ _____		♂	G. H. Ragsdale 8956
Cooke Co.	CMNH 25055	Adult	♂	_____
Comal Co.	USNM 77116	Adult	♂	W. H. Werner
Edwards Co.	USNM 184835	1st W.	♀	M. Cary
Hays Co.	TU _____	Adult	♂	R. R. Graber
Kerr Co.	AMNH 132889	Adult	♂	F. B. Armstrong
Kerr Co.	AMNH _____	Adult	♂	F. B. Armstrong 2057
Kerr Co.	AMNH _____	1st yr.	♂	F. B. Armstrong 2058
Kerr Co.	AMNH _____	Adult	♂	F. B. Armstrong 2059
Kerr Co.	AMNH _____	Adult	♂	F. B. Armstrong 2060
Kerr Co.	AMNH _____	Adult	♂	F. B. Armstrong 2061
Kerr Co.	AMNH _____	1st yr.	♂	F. B. Armstrong 2062
Kerr Co.	AMNH _____	?	♂	F. B. Armstrong 2063
Kerr Co.	AMNH _____	Adult	♂	F. B. Armstrong 9848
Kerr Co.	AMNH 378703	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378704	Adult	♂	A. P. Smith

Locality	Museum Number	Age	Sex	Collector
Kerr Co.	AMNH 378705	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378706	?	♂	A. P. Smith
Kerr Co.	AMNH 378707	Adult	♂	_____
Kerr Co.	AMNH 378708	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378709	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378710	Adult	♂	_____
Kerr Co.	AMNH 378711	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378712	Adult	♂	_____
Kerr Co.	AMNH 378713	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378714	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378715	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378716	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378717	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378718	?	♂	A. P. Smith
Kerr Co.	AMNH 378719	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378720	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378721	?	♂	A. P. Smith
Kerr Co.	AMNH 378722	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378723	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378724	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378725	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378726	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378727	1st yr.	♂	A. P. Smith
Kerr Co.	AMNH 378728	Adult	♂	A. P. Smith
Kerr Co.	AMNH 378734	Adult	♂	_____

Locality	Museum Number	Age	Sex	Collector
Kerr Co.	AMNH 378735	1st yr.	♂	_____
Kerr Co.	AMNH 378736	Adult	♂	_____
Kerr Co.	AMNH 378737	Adult	♂	_____
Kerr Co.	AMNH 378738	Adult	♂	_____
Kerr Co.	AMNH 378739	Adult	♂	_____
Kerr Co.	AMNH 378740	Adult	♂	_____
Kerr Co.	AMNH 378741	Adult	♂	_____
Kerr Co.	AMNH 378742	1st yr.	♂	_____
Kerr Co.	AMNH 378743	Adult	♂	_____
Kerr Co.	AMNH 378744	1st yr.	♀	_____
Kerr Co.	AMNH 378729	Adult	♀	A. P. Smith
Kerr Co.	AMNH 378730	?	♀	A. P. Smith
Kerr Co.	AMNH 378731	Adult	♀	A. P. Smith
Kerr Co.	AMNH 378732	1st yr.	♀	A. P. Smith
Kerr Co.	AMNH 378733	1st yr.	♀	A. P. Smith
Kerr Co.	UMMZ _____	1st yr.	♂	_____
Kerr Co.	TAM 453	Adult	♂	D. W. Lay
Kerr Co.	TAM 454	1st yr.	♂	B. E. Ludeman
Kerr Co.	TAM 455	Adult	♀	B. E. Ludeman
Kerr Co.	MVZ 41626	Adult	♂	C. S. Mueller
Kerr Co.	MVZ 41627	Adult	♂	A. P. Smith
Kerr Co.	MVZ 41628	1st yr.	♀	A. P. Smith
Kerr Co.	USNM 165151	Adult	♂	A. P. Smith
Kerr Co.	USNM 165152	?	♂	V. Bailey
Kerr Co.	USNM 165153	Adult	♂	V. Bailey

Locality	Museum Number	Age	Sex	Collector
Kerr Co.	USNM 184149	Adult	♂	M. Cary
Kerr Co.	USNM 184150	Juv.	♀	M. Cary
Kerr Co.	USNM 184834	Adult	♂	V. Bailey
Kerr Co.	USNM 184809	?	♂	V. Bailey
Kerr Co.	USNM 184808	1st yr.	♀	V. Bailey
Kerr Co.	CMNH 22304	Adult	♂	Isadore Prince?
Kerr Co.	CMNH 22305	Adult	♂	Isadore Prince
Kerr Co.	CMNH 22306	?	♂	Isadore Prince
Kerr Co.	CMNH 22307	1st yr.	♂	Isadore Prince
Kerr Co.	CMNH 22308	Adult	♂	Isadore Prince
Kerr Co.	CMNH 26990	Adult	♂	F. B. Armstrong
Kerr Co.	CMNH 26991	Adult	♂	F. B. Armstrong
Kerr Co.	CMNH 26992	1st yr.	♂	F. B. Armstrong
Kerr Co.	CMNH 26993	1st yr.	♂	F. B. Armstrong
Kerr Co.	CMNH 26994	Adult	♂	F. B. Armstrong
Kerr Co.	CMNH 26995	1st yr.	♂	F. B. Armstrong
Kerr Co.	CMNH 69350	Adult	♂	F. B. Armstrong
Kerr Co.	CMNH 69351	1st yr.	♂	F. B. Armstrong
Kerr Co.	CMNH 118867	1st yr.	♂	_____
Kerr Co.	CMNH 22309	1st yr.	♀	Isadore Prince
Kerr Co.	CMNH 26996	Adult?	♀	F. B. Armstrong
Kerr Co.	CMNH 26997	1st yr.	♀	F. B. Armstrong
Kerr Co.	CMNH 26998	Adult	♀	F. B. Armstrong
Kerr Co.	CMNH 26999	1st yr.?	♀	F. B. Armstrong
Kerr Co.	CMNH 27051	Adult?	♀	F. B. Armstrong

Locality	Museum Number	Age	Sex	Collector
Kerr Co.	CMNH 27052	Adult?	♀	F. B. Armstrong
Kerr Co.	CMNH 69352	Adult?	♀	_____
Kerr Co.	CMNH 69353	Adult	♀	_____
Kimble Co.	USNM 342705	Adult	♂	T. D. Burleigh
Kinney Co.	TU _____	Adult	♂	R. R. Graber
Medina Co.	UMMZ _____	Adult	♀	A. J. Kirn
Menard Co.	AMNH 378745	Adult	♂	A. P. Smith
Terrell Co.	TU 292356	Juv.P.J.	♂	W. A. Thornton
Travis Co.	AMNH 2063	?	♂	C. D. Oldright
Tom Green Co.	USNM 109494	Adult	♂	W. Lloyd
Tom Green Co.	USNM 109496	1st yr.	♀	W. Lloyd
Uvalde Co.	TU _____	Adult	♂	R. R. Graber
Valverde Co.	USNM 137754	1st W.	♂	W. Lloyd
Valverde Co.	USNM 137755	Adult	♂	W. Lloyd
Valverde Co.	USNM 141747	Adult	♂	W. Lloyd
Valverde Co.	USNM 166646	Adult	♂	V. Bailey
Valverde Co.	USNM 168272	Adult	♂	H. C. Oberholser
Valverde Co.	USNM 184836	Adult	♂	M. Cary
Valverde Co.	USNM 184837	1st W.	♂	M. Cary
Valverde Co.	USNM 184838	?	♂	M. Cary
Valverde Co.	USNM 6818	Adult	♂	J. H. Clark
*Valverde Co.	AMNH 1696	Adult	♂	_____
Mexico				
Coahuila	MVZ 107441	1st yr.	♂	H. H. Kimball

Locality	Museum Number	Age	Sex	Collector
Coahuila	MVZ 129897	1st yr.	♂	A. H. Miller
Coahuila	MVZ 129900	1st yr.	♂	A. H. Miller
Coahuila	MVZ 129898	?	♀	A. H. Miller
Coahuila	MVZ 129901	?	♀	A. H. Miller
Coahuila	KU 31493	Adult	♂	R. W. Dickerman
Coahuila	KU 31494	1st yr.	♂	R. W. Dickerman
Coahuila	KU 32099	Adult	♂	S. Anderson
Coahuila	KU 32100	Adult	♂	S. Anderson
Coahuila		Adult	♂	R. R. Graber
Coahuila		Adult	♀	R. R. Graber
Coahuila	OU _____	Adult	♂	H. Land
Guerrero	MVZ 112769		♀	W. W. Brown
Jalisco	AMNH 505141	Adult	♂	A. C. Butler
Mexico	USNM 143445	Adult	♂	E. W. Nelson
Morelos	MMNH 10983		♂	D. W. Warner
Nayarit		1st W.	♂	A. R. Phillips 2947
Nayarit		1st W.	♀	A. R. Phillips 2981
Nayarit		1st W.	♂	A. R. Phillips 2997
Nayarit		Adult	♂	A. R. Phillips 3009
Nayarit		Adult	♂	A. R. Phillips 4055
Nayarit	_____	1st W.	♂	R. R. Graber
Nayarit	_____	1st W.	♀	R. R. Graber

Locality	Museum Number	Age	Sex	Collector
Sinaloa	USNM 55046	1st W.	♀	A. J. Grayson
Sinaloa	_____	Adult	♂	R. R. Graber

Total Number of Specimens Examined 175

*Paratype

PHOTOGRAPHS

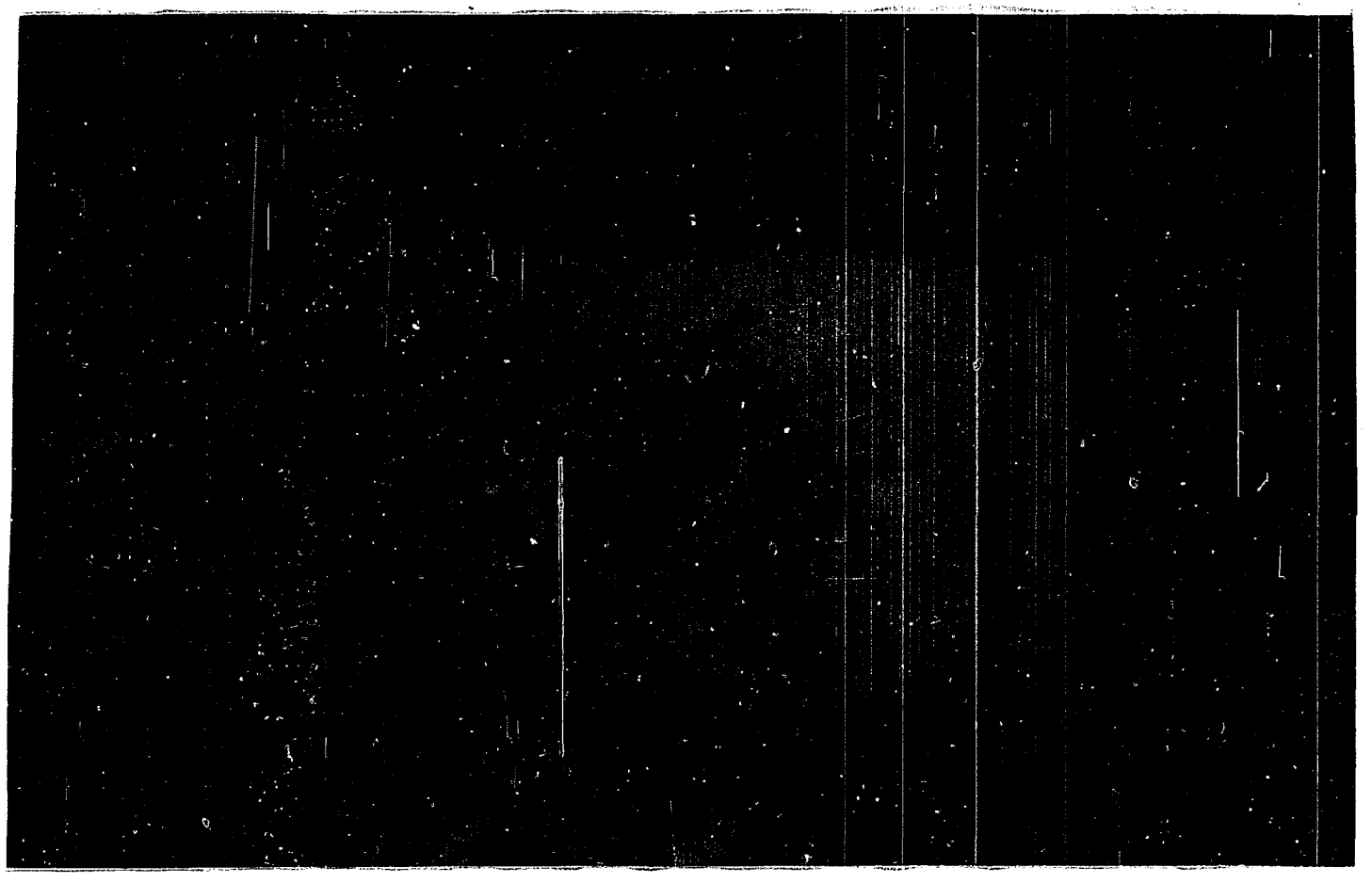


Figure 1. Nestmates. Larger cowbird chick four days old, smaller cowbird three days old, and black-capped vireo chick one-half day old (right). Photo taken July, 1956, Comal County, Texas.



Figure 2. Black-capped vireo nest *in situ*. Photo taken July 1956, Caddo County, Oklahoma.



Figure 3. Adult male black-capped vireo at nest. Compare darkness of head with that of female below.



Figure 4. Adult female at nest. Photos taken July 1956, Comal County, Texas.

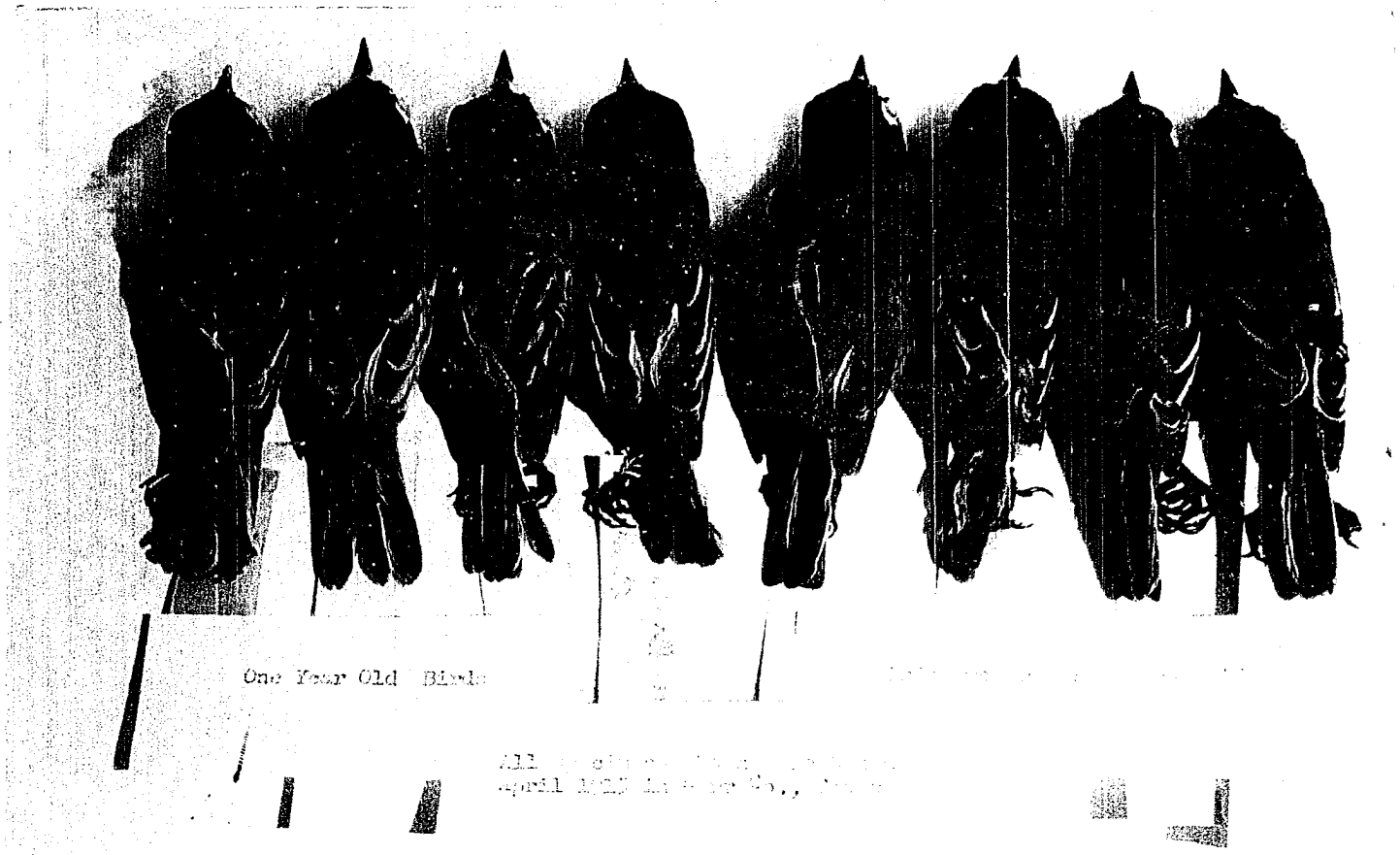


Figure 5. Eight males taken April, 1915, in Kerr County, Texas. Darkness of head correlates with age; four birds on left less than one year old (aging based retention of primary coverts and flight feathers); four on right, two or more years old.

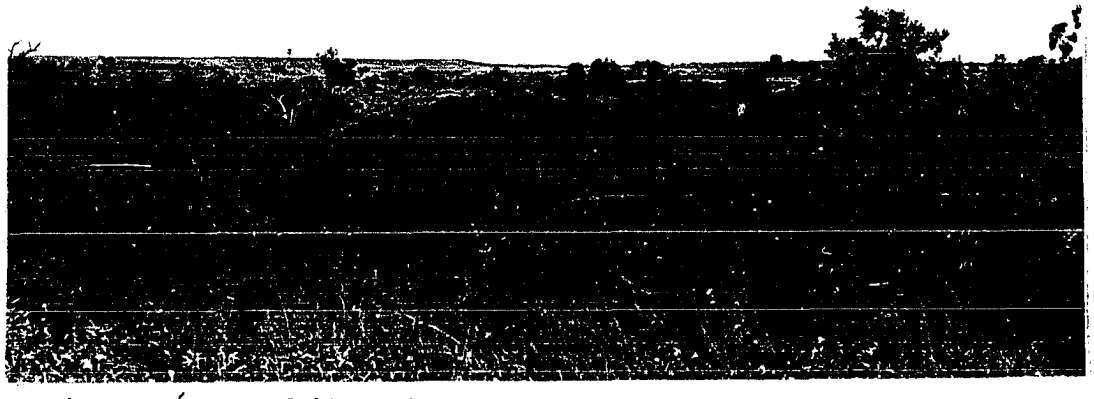


Figure 6. Habitat in extreme northern part of breeding range. Photo taken August, 1955, in Dewey County, Oklahoma.

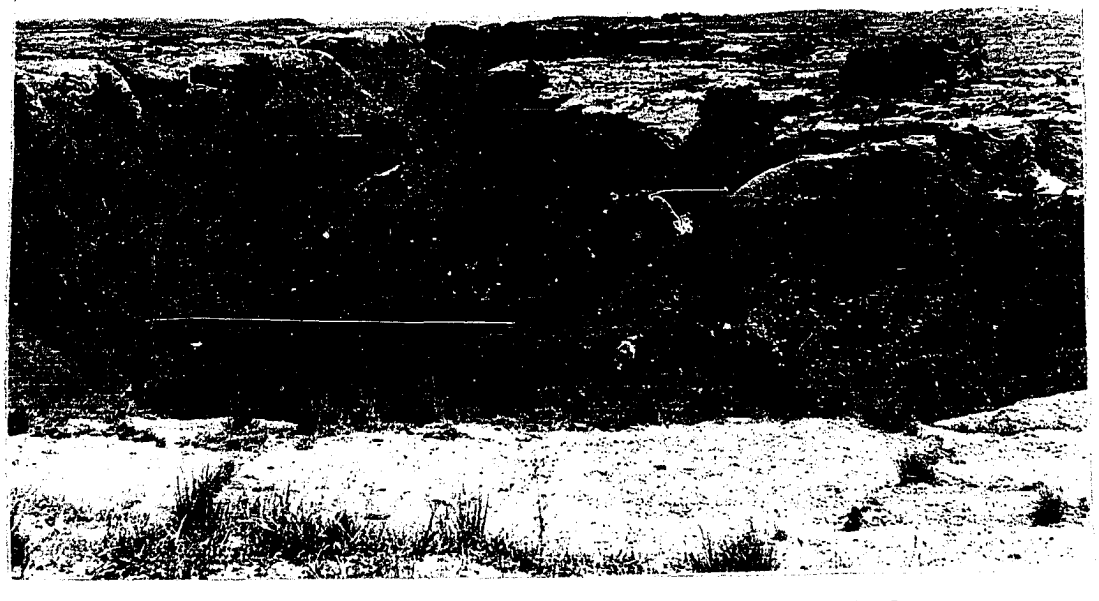


Figure 7. Canyon near that in which Goss (1885) collected the species in Comanche County, Kansas. Photo taken July, 1955.



Figure 8. Habitat in northern part of breeding range. Blackjack oak-post oak-red cedar covered canyon slopes. Photo taken May, 1954, in Caddo County, Oklahoma.



Figure 9. Height of vegetation in northern breeding habitat. Same area as above.



Figure 10. Live oak-cedar habitat in Comal County, Texas. Photo taken May, 1956, at El Rancho Cima.



Figure 11. Closer view of habitat above. Spanish and live oak over cedar understory.

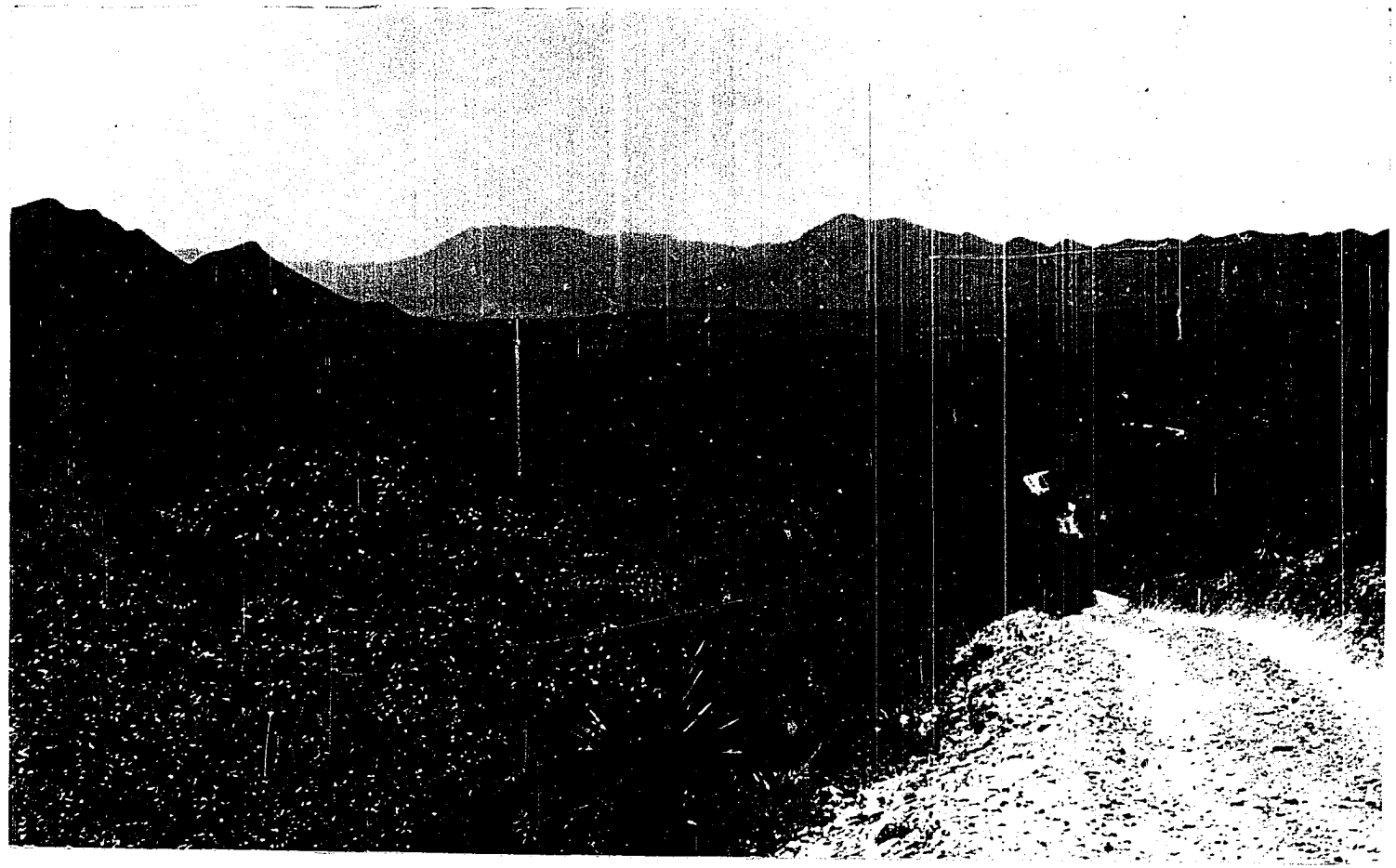


Figure 12. Habitat in southern part of breeding range. Scrub-covered slopes of Sierra Padilla which lies 16 miles east, 18 north of Ocampo, Coahuila. Photo taken June, 1956.

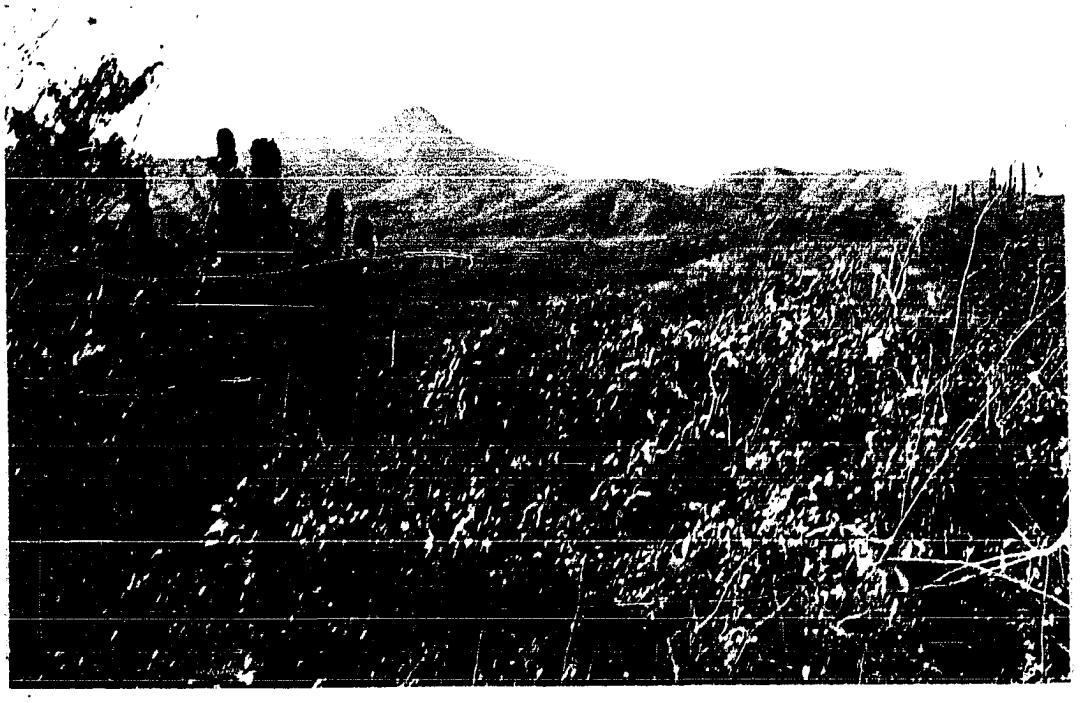


Figure 13. Wintering habitat in southern Sinaloa, Mexico. Arid, coastal foothills near Concordia. Photo taken December, 1955.



Figure 14. Detail of arid scrub. Much of vegetation without leaves in dry season of year. Photo taken in same area as above.



Figure 15. Wintering habitat in Nayarit, Mexico. Hilly terrain 20 miles west of Compostela. Photo taken December, 1955.



Figure 16. Same area as above. Two male black-capped vireos were seen in the bushes left of the truck.