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Douglas A. James
University of Arkansas, Fayetteville

Christopher J. Kellner
Arkansas Tech University

Jan Self
Ozark National Forest

Jerry Davis
Ouachita National Forest

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Douglas A. James*
Department of Biological Sciences
University of Arkansas
Fayetteville, AR 72701

Christopher J. Kellner
Department of Biology
Arkansas Tech University
Russellville, AR 72801

Jan Self
Buffalo Ranger District
Ozark National Forest
P.O. Box 427
Jasper, AR 72641

Jerry Davis
Forest Wildlife Program Manager
Ouachita National Forest,
P.O. Box 1270
Hot Springs, AR 71902

*Corresponding Author

Abstract

The Cerulean Warbler (*Dendroica cerulea*) has been declining in numbers in its North American nesting range, and the same is true in Arkansas. To provide specific sites that can be monitored in the future, this study describes places where the bird was documented in the state in the 1990s. The warbler was found in mature deciduous forest in both upland and bottomland situations but was most abundant in the upland Ozark forests and uncommon in other regions of the state. Most (70%) of the occupied sites were on federal and state lands. Pattern of overall distribution was essentially the same in the 1990s as it was in an earlier period through 1973. Data in one case suggest that group selection type of forest harvest may produce habitats that are beneficial to Cerulean Warblers.

Introduction

Overall trends from the Breeding Bird Survey (Sauer et al., 1997) show Cerulean Warblers (*Dendroica cerulea*) declined at a rate of 3.7% per year from 1966 to 1996 in the nesting range comprising eastern North America (AOU, 1998). In Arkansas, where the species occurs in relatively low abundance, the decrease is estimated at less than 1.5% per year (Sauer et al., 1997). This situation led to investigation of the status of the species by establishing the Cerulean Warbler Atlas Project coordinated in the Partners In Flight program at the Laboratory of Ornithology, Cornell University (Rosenberg et al., 1998). Volunteers searched for the warbler and submitted reports that were compiled at Cornell for the years 1997 to 1999.

The present paper lists records obtained by observers in Arkansas from 1990 to 1999. This longer period provides a better view of the bird's current distribution and abundance in the state than just a year or two of searching. The main objectives of the study are 1) to determine the present status of Cerulean Warblers in Arkansas, and 2) to carefully document their present locations so that these sites may be monitored in the future to determine population trends.

Methods

Records of breeding season (late May through July) Cerulean Warblers for the 1990s in Arkansas were sought from a variety of sources. Key observers of birds in the state were consulted, the Bird Record Files of the Arkansas Audubon Society (curated by Max Parker of Malvern, Arkansas) were searched, personnel at the National Forests in Arkansas and Arkansas Natural Heritage Commission were consulted, and results from the ongoing Arkansas Breeding Bird Atlas were screened, as were the Breeding Bird Survey findings in the 1990s (USGS 1999). In addition, Jennifer Akin was hired from end of May through most of June 1998 to search previously known Cerulean Warbler sites and many potential new sites in the lowlands of southern and eastern Arkansas.

Only one person noted a singing male was present, and only two recorded the presence of male and female and young. For all the other records there was no indication of sex and age of the birds or whether singing or not. It is presumed, however, that the reports were mainly of singing males heard, followed by searching and sighting of the vocalizing individuals, because hearing the song is essentially the only way to find this small bird that dwells hidden in lofty forest canopies. In the many reports of several birds at a site there was no indication of the sexes of the birds and again it is presumed that most were vocalizing males. If this had been a systematic survey, which it was not, forms detailing information to report would have been distributed in advance. Instead, the study relied on past records submitted in diverse formats. Nevertheless, these records do document well the important data and main focus of this paper, which is to determine locations where Cerulean Warblers now occur for use in future surveys on the status of the bird. Other matters, including date of observation in the breeding season, number of birds found, and sex and age ratios, are

ɔt of central importance.

In every case, the number of birds present was record- and an attempt was made to precisely document the sites cording to section, township, and range designations plus itude and longitude of each location. Elevation and type habitat were noted, in addition to date and observer. Most ɔservations included all of the above. However, informa- ɔn was incomplete for some sightings. A few records, par- cularly those early in the decade, could only be located ith respect to the nearest town. The warbler site data ɔown below bearing Kellner's name prior to 1998 for the)zark National Forest contain discrepancies between lati- ude and longitude designations and corresponding section, ownship and range positions. This resulted from difficulties n transposing between the two systems using points marked on topographic maps. This discrepancy was eliminated 1998 and 1999, when Kellner determined lat-long coordinates directly in the field using a Global Positioning System (GPS) instrument. (Although section designations were the location data provided for most sites, latitude and longitude were added obtained from mapped positions because that is the site information used at Cornell University to construct the Cerulean Warbler Atlas.)

Results

The numbers of Cerulean Warblers found in Arkansas from 1990 through 1999 and their locations are listed below by physiographic region in Arkansas and alphabetically by county within the physiographic regions. The format for each listing is as follows: 1) the county, 2) section, township and range, 3) latitude and longitude, 4) elevation of the site, 5) the number of birds found at the site, 6) date(s), 7) habitat, 8) observers(s) (some of these items were not available for some sites because various observers had their own formats for reporting sightings). When the site was on public lands, a designation was appended to those site listings showing what agency was involved. These are BNR=Buffalo National River, DDP=Devil's Den State Park, HCWA=Howard County Wildlife Management Area, OUNF=Ouachita National Forest, OZNF=Ozark National Forest, and WRWR=White River National Wildlife Refuge. (Scientific names for vernacular names of trees named in habitat descriptions are given in the Appendix using the terminology of Smith, 1988 and Hunter, 1989.)

As already explained, most records were of presumably singing male birds, but a few times females and non-singing males, and even young birds, were reported too and not separately enumerated. When a specific number of birds at a site is associated with several dates at that site it means that number of Cerulean Warblers was found there on each of the dates. When there is a range of numbers given it means the observer(s) could not tell exactly how many. If the range was associated with two or more dates it means different numbers of birds were found there on the different dates, specifics often not provided. In totaling bird numbers (Table 1) the upper value in a range of numbers was used. When the number of birds was not reported the phrase "at least 1 bird" is used and one bird is added to the total in each case. If only the year is given, the exact date is not known but the observation was indeed made in the period from late May through July. The exact positions of warbler sites in the two National Forests are available on maps kept in the respective forest offices, but map positions were not submitted with most other records. Elevations are given first in feet, followed by conversions to meters, because both the contour maps used and GPS data submitted were in feet.

The most important information is locations of warbler sightings, and this therefore is listed first beginning with the county, because it provides instructions on how to find the sites in the future when determining changes in status through the years. Because the records submitted were mainly opportunistic discoveries of Cerulean Warblers from a variety of observers and not based on systematic surveys, obviously many sites were missed. The statewide coverage was uneven with a concerted effort being made only in the Ozark National Forest. Nevertheless, records came from every region of the state.

In most cases only one bird was present at a site, in others more than one. Sometimes the observer was not sure of the number, and sometimes the number varied with visits to the site. Primarily, however, there was only one visit reported for each site. In any case, the number of birds found is not as valid as the actual site locations because certainly at all sites there could have been birds that were missed. Therefore, the numbers of Cerulean Warblers found is only an estimate of the minimum numbers present.

Except for the exact warbler locations marked on the maps mentioned above available in the offices of the two National Forests, the other locations are identified as shown below no closer than township section, or nearest minute of latitude and longitude. This means that some searching will be necessary in relocating these sites in the future. Fortunately most sightings were along roads, and not many roads exist in a single township section, and along roads in general there are few forest patches suitable for Cerulean Warblers. These two criteria can be used in future searches for the sites reported below.

The dates of the sightings are given but special importance should not be attributed to specific dates. Since all dates are within the breeding season for Cerulean Warblers in Arkansas (late May through July) it is assumed that the birds at any site would have been found on any date in that period. Therefore, the dates simply indicate when the observer happened to be at a particular site. For some sites listed below only the year of the observation is given because the specific date in the breeding season was not reported.

Forest type was reported only in very general terms often indicating little more than degree of maturity, or whether upland or bottomland topography, or mentioning basic types of trees. This was the information most commonly omitted in incomplete reporting.

Ozark Plateaus Region

1) Benton, S13 T20N R28W, 36°24'N 93°54'W, 1500 ft (457 m), 1 bird, late June 1996, 9 May 1998, upland oak-hickory forest, Ellen Neaville.

2) Benton, S7 T17N R32W, 36°10'N 94°26'W, 965 ft (294 m), 3 birds, 18 June 1998, mature silver maple and box elder bottomland forest with protruding introduced tulip tree grove, Steve Duzan, Doug James, Abby Powell, OZNF.

3) Carroll, S6 T17N R22W, 39°09'N 93°21'W, 2000 ft (610 m), 1-3 birds, 17 & 13 May and 4 June 1994, 23 & 25 May 1997, upland oak-hickory forest, Mike Mlodinow.

4) Carroll, S4 T18N R22W, 36°15'N 93°19'W, 1200 ft (366 m), 1 bird, 8 June 1995, 13 & 16 May 1996, 15 June 1997, upland oak forest, Mike Mlodinow.

5) Crawford, S13 T12N R30W, 35°42'N 94°08'W, 1500 ft (457 m), 2 birds, 12 June 1998, mature upland oak-hickory forest, R. Kannan, Doug James, David Chapman.

6) Crawford, S26 T12N R33W, 35°42'N 44°28'W, 1000 ft (305 m), 3 birds, 22 May 1999, Steve Duzan, Ralph Oldegard, OZNF.

7) Crawford, S13 T12N R33W, 35°43N 94°27'W, 1500 ft (457 m), 3 birds, 24 May 1999, upland oak-hickory forest, John Prather, Jeff Briggler, OZNF.

8) Crawford, S24 T12N R33W, 35°42'N 94°28'W, 1250 ft (381 m), 1 bird, 4 June 1999, upland oak-hickory forest, Jeff Briggler, OZNF.

9) Franklin, 35°41'N, 93°49'W, 2 birds, June 1994, Boston Mountain route of Breeding Bird Survey, John Andre, OZNF.

10) Franklin, S36 T13N R27W, 35°44'N 93°48'W, 2250 ft (686 m), 7 birds, 3 July 1994, 23 May 1998, mature upland northern red oak-hickory forest, Paul Rodewald, Doug James, Jennifer Akin, OZNF.

11) Franklin, S25 T12N R28W, 35°41'N 93°56'W, 1500 ft (457 m), 1 bird (singing male), July 1998, upland oak-hickory forest, John Prather, OZNF.

12) Johnson, S20 T11N R21W, 35°35'N 93°14'W, 1530 ft (466 m), 1 bird, 2 June 1999, mature upland northern red and white oak forest, Chris Kellner, OZNF.

13) Madison, north of Marble, 1 bird, summer 1998, upland shortleaf pine-oak forest, Donna O'Daniel.

14) Madison, S12 T15N R28W, 35°53'N 93°55'W, 1500 ft (457 m), 1 bird, early June 1995, upland oak-hickory forest, Mike Mlodinow.

15) Pope, S26 T12N R21W, 35°40'N 93°13'W, 1400 ft (427 m), 1 bird, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

16) Pope, S20 T12N R20W, 35°40'N 93°09'W, 1000 ft (303 m), 5 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

17) Pope, S32 T12N R20W, 35°39'N 93°08'W, 1000 ft (305 m), 1 bird, 27 May 1998, upland mature northern red oak forest, Chris Kellner, Jan Self, OZNF.

18) Pope, S6 T11N R19W, 35°38'N 93°03'W, 1400 ft (427 m), 4 birds, May 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

19) Pope, S29 T12N R19W, 35°39'N 93°02'W, 1600 ft (489 m), 3 birds, 20 May 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

20) Pope, S30 T12N R19W, 35°39'N 93°03'W, 1400 ft (427 m), 3 birds, 20 May 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

21) Pope, S10 T12N R20W, 35°43'N 93°06'W, 1640 ft (500 m), 2 birds, 21 May 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

22) Pope, approx 35°39'N 93°03'W, 1750 ft (533 m), 2 birds with young, 6 June 1994, upland forest, Paul Rodewald, OZNF.

23) Pope, S19 T11N R19W, 35°35'N 93°03'W, 1500 ft (457 m), 5 birds, 5 June 1994, Paul Rodewald, OZNF.

24) Pope, S12 T12N R20W, 35°42'N 93°04'W, 1800 ft (549 m), 20 birds, June & July 1993, 16 May 1994, 6 May 1996, 28-30 May 1997, May 1998, mature upland northern red oak forest, Paul Rodewald, John Andre, Chris Kellner, OZNF.

25) Pope, S11 T12N R20W, 35°43'N 93°05'W, 1900 ft (579 m), 8 birds, May 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

26) Pope, S2 T12N R20W, 35°43'N 93°05'W, 2000 ft (610 m), 2 birds, June 1997, May & June 1998, Chris Kellner, Jan Self, John Prather, OZNF.

27) Pope, S8 T12N R18W, 35°42'N 93°55'W, 2000 ft (610 m), 3 birds, 2 June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

28) Pope, S18 T11N R14W, 35°36'N 93°03'W, 1400 ft (427 m), 1 bird, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

29) Pope, S5 T11N R14W, 35°38'N 93°02'W, 1600 ft (488 m), 2 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

30) Pope, S9 T11N R9W, 35°37'N 93°02'W, 1400 ft (427 m), 6 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

31) Pope, S8 T11N R19W, 35°37'N 93°02'W, 1600 ft (488 m), 5 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

32) Pope, S7 T11N R19W, 35°37'N 93°03'W, 1700 ft (518 m), 3 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

33) Pope, S19 T11N R19W, 35°35'N 93°03'W, 1500 ft

57 m), 1 bird, June 1998, 27 May 1999, upland forest, John ather, OZNF.

34) Pope, S9 T12N R20W, 35°42'N 93°06'W, 1890 ft 76 m), 7-8 birds, 22 June 1999, mature upland northern d and white oak forest, Chris Kellner, OZNF.

35) Pope, S15 T12N R20W, 35°41'N 93°05'W, 1740 ft 30 m), 5-6 birds, 24 June 1999, mature upland northern d and white oak forest, Chris Kellner, OZNF.

36) Pope, S8 T12N R18W, 35°41'N 92°55W, 1940 ft 91 m), 1 bird, 29 July 1999, mature upland northern red id white oak forest, Chris Kellner, OZNF.

37) Newton, 35°49'N 93°04'W, 1-2 birds, June 1993, 994, 1996, 1997, Lurton route Breeding Bird Survey, Lance Peacock, OZNF.

38) Newton, 36°06'N 93°17'W, 1-2 birds, June 1990, 1993, 1994, 1995, Compton route Breeding Bird Survey, Joe Neal, BNR.

39) Newton, S2 T14N R21W, 35°53'N 93°11'W, 2000 ft (610 m), 1-7 birds, end of May 1998, Jan Self, OZNF.

40) Newton, S36 T14N R20W, 35°49'N 92°58'W, 2000 ft (610 m), 2 birds, end of May 1998, Jan Self, OZNF.

41) Newton, S35 T17N R23W, 36°06'N 93°22'W, 2000 (610 m) ft, 1-5 birds, 11 May to 16 June 1994 (4 dates), 22 May to 16 June 1995 (5 dates), 20 May to 9 June 1996 (3 dates), 14 May to 6 June 1997 (4 dates), upland oak-hickory forest, Mike Mlodinow.

42) Newton, S18 T16N R22W, 36°02'N 93°21'W, 1800 ft (549 m), 1 bird, 29 May and 7 June 1995, 22 May 1996, upland oak-hickory forest, Mike Mlodinow.

43) Newton, S19 T14N R22W, 35°51'N 93°22'W, 2000 ft (610 m), 1 bird, 10, 13, 14 June 1998, upland oak forest, edge of group selection cut, Mike Mlodinow, OZNF.

44) Newton, S15 T15N R23W, 35°30'N 93°24'W, 1200 ft (366 m), 1 bird, 1993, upland forest, Chris Kellner, Jan Self, OZNF.

45) Newton, S14 T14N R42W, 35°53'N 93°28'W, 2000 ft (610 m), 1 bird, 1993, upland forest, Chris Kellner, Jan Self, OZNF.

46) Newton, S2 T14N R21W, 35°54'N 93°11'W, 1500 ft (457 m), 5 birds, 3 June 1997, upland forest, Chris Kellner, Jan Self, OZNF.

47) Newton, S6 T14N R20W, 35°54'N 93°09'W, 1500 ft (457 m), 3 birds, 3 June 1997, upland forest, Chris Kellner, Jan Self, OZNF.

48) Newton, S7 T14N R20W, 35°53'N 93°09'W, 1800 ft (549 m), 2 birds, June 1997, upland forest, Chris Kellner, Jan Self, OZNF.

49) Newton, S21 T14N R22W, 35°51'N 93°19'W, 2180 ft (665 m), 1 bird, 30 May 1996, upland forest, Chris Kellner, Jan Self, OZNF.

50) Newton, S33 T14N R22W, 35°50'N 93°20'W, 1480 ft (551 m), 1 bird, 20 June 1995, upland forest, Chris Kellner, Jan Self, OZNF.

51) Newton, S31 T14N R22W, 35°50'N 93°22'W, 1740 ft (530 m), 1 bird, 2 May 1996, upland forest, Chris Kellner, Jan Self, OZNF.

52) Newton, S8 T13N R22W, 35°48'N 93°21'W, 1360 ft (415 m), 1 bird, 7 June 1995, upland forest, Chris Kellner, Jan Self, OZNF.

53) Newton, S29 T14N R20W, 35°50'N 93°08'W, 1660 ft (506 m), 1 bird, 18 June 1995, upland forest, Chris Kellner, Jan Self, OZNF.

54) Newton, S6 T14N R20W, 35°54'N 93°09'W, 1700 ft (518 m), 2 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

55) Newton, S31 T14N R22W, 35°50'N 93°22'W, 1500 ft (457 m), 2 birds, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

56) Newton, S8 T13N R22W, 35°48'N 93°21'W, 1500 ft (457 m), 1 bird, June 1998, mature upland northern red oak forest, Chris Kellner, Jan Self, OZNF.

57) Newton, S6 T14N R22W, 35°53'N 93°21'W, 1340 ft (408 m), 1 bird, 1996, Jan Self, Chris Kellner, OZNF

58) Newton, S35 T14N R24W, 35°50'N 93°30'W, 2250 ft (686 m), 1 bird, 1993, Jan Self, Chris Kellner, OZNF.

59) Newton, S14 T14N R24W, 35°52'N 93°29'W, 2300 ft (701 m), 2 birds, 1993, Jan Self, Chris Kellner, OZNF.

60) Newton, S24 T14N R24W, 35°53'N 93°29'W, 2000 ft (610 m), 2 birds, 1993, Jan Self, Chris Kellner, OZNF.

61) Newton, S25 T14N R24W, 35°51'N 93°28'W, 1900 ft (579 m), 2 birds, 1993, Jan Self, Chris Kellner, OZNF.

62) Newton, S30 T14N R23W, 35°51'N 93°28'W, 2000 ft (610 m), 2 birds, 1993, Jan Self, Chris Kellner, OZNF.

63) Newton, S31 T14N R23W, 35°50'N 93°28'W, 2200 ft (671 m), 1 bird, June 1998, Jan Self, Chris Kellner, OZNF.

64) Newton, S6 T13N R23W, 35°49'N 93°28'W, 1700 ft (518 m), 1 bird, 1993, Jan Self, Chris Kellner, OZNF.

65) Newton, S5 T13N R23W, 35°49'N 93°27'W, 1800 ft (548 m), 2 birds, 1993, Jan Self, Chris Kellner, OZNF.

66) Newton, S10 T13N R23W, 35°48'N 93°25'W, 1600 ft (488 m), 1 bird, 1 June 1995, Jan Self, Chris Kellner, OZNF.

67) Stone, S 5&6 T16N R12W, 36°03'N 92°18'W, 750 ft (229 m), possibly 5 birds, 1996, riverine forest, Bob Clearwater, OZNF.

68) Stone, S1 T16N R12W, 36°03'N 92°12'W, 1000 ft (305 m), 1 bird, 1997, upland forest, Glen Thomas, OZNF.

69) Stone, S16 T16N R12W, 36o°02'N 92°15'W, 750 ft (229 m), 1 bird, 1998, bottomland forest, Glen Thomas, OZNF.

70) Stone, S3,4,11 T15N R11W, approximately 35°57'N 92°09'W, 500 ft (152 m), possibly 5 birds, 1998, bottomland forest, Larry Hedrick, OZNF.

71) Van Buren, 35°38'N 93°34'W, June 1994, Rupert route Breeding Bird Survey, 1 bird, June 1994.

72) Van Buren, east of Shirley, T12N, R12W, approxi-

mately 35°40'N 92°15'W, 550 ft (168 m), 3 birds, 25 May 1991, Bo and Don Verser.

73) Washington, S25 T15N R31W, 35°47'N 94°15'W, 1200 ft (366 m), 1 bird, 31 May 1998, mature upland oak-hickory forest, Mike Mlodinow, David Chapman, DDP.

Ouachita Mountains Region

74) Hot Spring, Social Hill area, approximately 34°20'N 92°55'W, at least 1 bird, 300 ft (91 m), 4 July 1994, bottomland forest, Jerry Davis.

75) Howard, Howard County Wildlife Management Area, approximately 34°13'N 94°10'W, 830 ft (253 m), 2 birds, 2,7 June 1990, Helen and Max Parker, HCWA.

76) Logan, S4 T4N R26W, 35°02'N 93°46'W, 1500 ft (457 m), at least 1 bird, 15 June 1994, mature upland white oak-hickory forest, Joe Neal, OUNF.

77) Montgomery, S27 T4S R27W, 34°23'N 93°53'W, 958 ft (292 m), 2 birds (1 at each of 2 adjacent locations), 29 May 1998, bottomland sweet gum, sugar maple, white oak forest, Jennifer Akin, OUNF.

78) Montgomery, S14 T1S R23W, 34°39'N 93°26'W, 600 ft (183 m), at least 1 bird, 7 July 1995, mature bottomland oak-hickory forest, Jerry Davis, OUNF.

79) Montgomery, S32 T4S R27W, 34°21'N 93°55'W, 1000 ft (305 m), 5 birds, 29 June 1994, mature oak-hickory-sweet gum riparian forest, Jerry Davis and Larry Hedrick, OUNF.

80) Montgomery, S29 T2S R27W, 34°32'N 93°55', 900 ft (274 m), at least 1 bird, cut over bottomland hardwood forest, Larry Hedrick.

81) Polk, S12 T1S R32W, 34°45'N 94°22'W, 2000-2250 ft (610-685 m), 3 birds, 13 June 1999, mid-aged upland black oak, white oak, cucumber tree forest, Doug James, David Chapman, OUNF.

Gulf Coastal Plain Region

82) Calhoun, S10 T16S R14W, 33°21'N 92°32'W, 82 ft (25 m), 1 bird, 3 June 1998, bottomland beech, sweet gum, oak forest, Jennifer Akin.

83) Clark, 34°03'N 93°15'W, 1 bird, June 1990 & 1995, Hollywood route Breeding Bird Survey, Helen Parker.

84) Clark, S34 T6S R22W, 34°10'N 93°14'W, 350 ft (107 m), 1 bird, 6 July 1998, mature oaks, sweet gum, sycamore forest. Max and Helen Parker.

85) Cleveland, S17 T10S R10W, 33°51'N 92°09'W, 93 ft (28 m), 2 birds, 8 June 1998, Bottomland black willow, silver maple, sycamore forest, Jennifer Akin.

86) Grant, S21 T4S R12W, 34°22'N 92°18'W, 250 ft (76 m), 1 bird, 8 June 1998, mature upland-bottomland forest with hickories, oaks, sweetgum dominants, Helen Parker.

87) Grant, S4 T4S R15W, 34°24'N 92°42'W, 250 ft (76 m), 1 bird, 28 May 1990, mature bottom land forest, Helen and Max Parker.

88) Union, SE of Strong, T19S R12W, approximately 33°03'N 92°20'W, 100 ft (31 m), 3 birds (adults feeding young), 25 May 1996, Cade and Mary Coldren.

Mississippi Delta Region

89) Arkansas, 34°16'N 91°06'W, 172 ft (52 m), 1 bird, 1992, bottomland forest, Paul Hamel, WRWR.

90) Desha, 33°44'N 91°09'W, 146 ft (45 m), over 10 birds, 1992 and 1998, bottomland forest, Paul Hamel.

91) Desha, on Big Island across Mississippi River from Rosedale, Miss., approximately 33°45'N 91°10'W, 150 ft (46 m), 8 birds, 20 June 1991, mature bottomland forest, Bo Ford.

92) Desha, near Rohwer, approximately 33°45'N 91°14'W, 145 ft (44 m), 5-13 birds, 29-30 June 1991, 4 July 1992, Bob Ford.

93) Monroe, White River National Wildlife Refuge north of Highway 1, T3S R1W, approximately 34°25'N 91°05'W, 175 ft (53 m), 1-2 birds, 24 May and 27 June 1991, Bob Ford, WRWR.

94) Monroe, 34°24'N 91°07'W, 174 ft, 1 bird, 1992, bottomland forest, Paul Hamel, WRWR.

95) Phillips, one site, 2 birds, 1992, mature bottomland forest, Robert Cooper, WRWR.

96) Phillips, 1 bird, another site, 1992, mature bottomland forest, Robert Cooper, WRWR.

97) Prairie, S20 T4N R4W, 34o°57'N 91°27'W, 183 ft (56 m), 1 bird, 21 May 1998, mature bottomland mixed oaks, sweet gum, bald cypress forest, Max and Helen Parker.

Table 1. Number of Cerulean Warbler sites and maximum numbers of birds reported at the sites in each physiographic region of Arkansas.

Physiographic region	Number of sites	Number of birds
Ozarks	73	196
Ouachitas	8	16
Coastal Plain	7	10
Delta	9	39
Total	97	261

Discussion

Cerulean Warblers were detected at 97 sites (Table 1) in Arkansas from 1990 to 1999, comprising a combined total of 261 birds. By far the most sites and birds were in the Ozark Plateaus physiographic region (Table 1, Fig. 1) in

rthern Arkansas especially in the northwestern part of the te. The species was uncommon in the rest of the state. pulation centers (Fig. 1) were in upland forests in adjoin- Newton and Pope Counties in the Ozarks (57 and 92 ds documented, respectively) and in bottomland forests Desha County (31 birds) in the Delta region.

The importance of extensive forests existing on public ds was pronounced. Over two-thirds of the sites (68 out 97 total equals 70%) occurred on such properties, with most (57 sites) in the Ozark National Forest, followed by 5 sites each in the Ouachita National Forest and White River National Wildlife Refuge, and one site each at the Buffalo National River, Devil's Den State Park and Howard County Wildlife Management Area (Arkansas Game & Fish Commission). The overall pattern of habitat types occupied amplifies what has been reported for Cerulean Warblers in

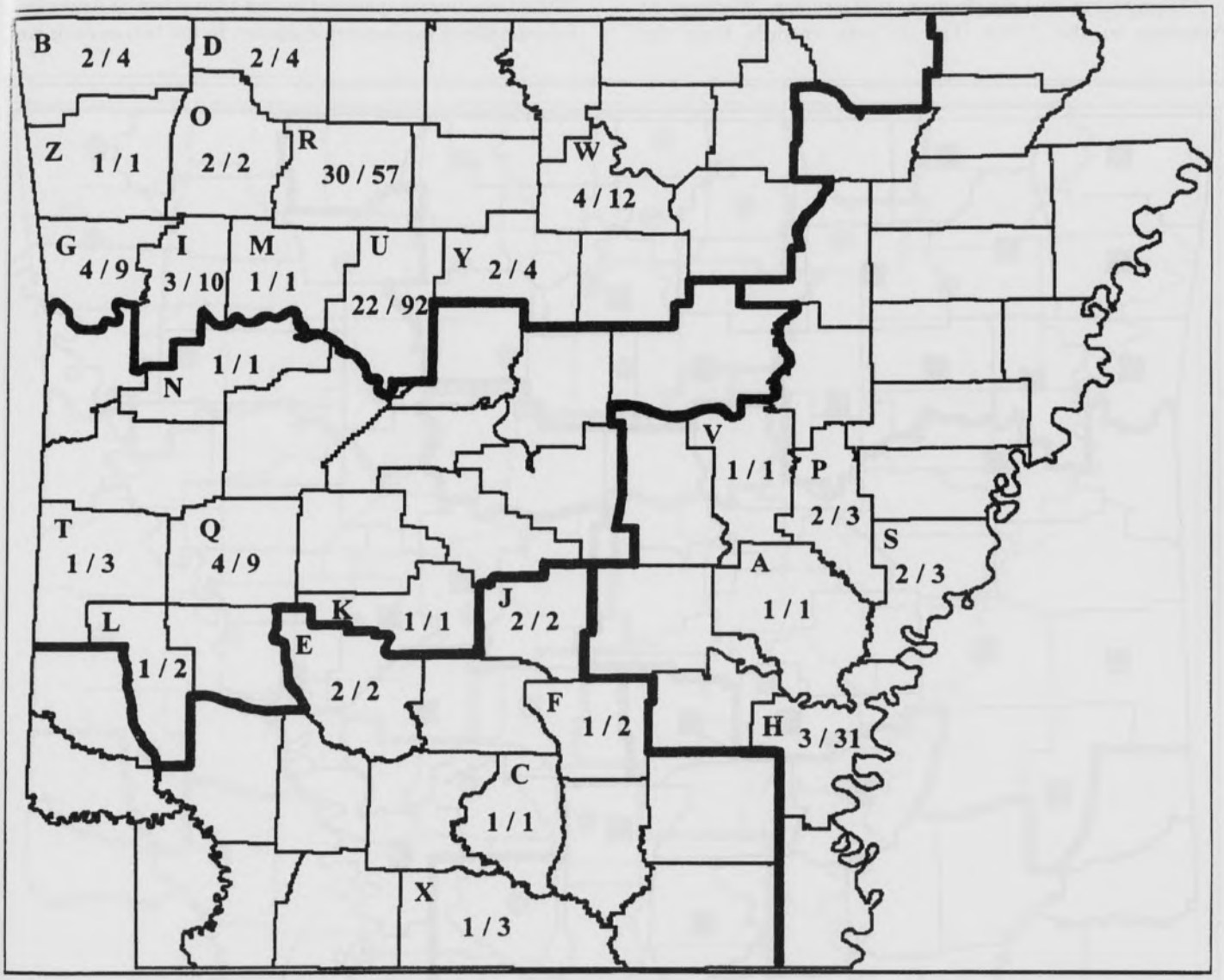

Fig. 1. Number of Cerulean Warbler sites (before the slash) and number of birds at the sites (after the slash) in the Arkansas counties where the birds were found in the 1990s. The bold lines outline physiographic regions in the state which are the Ozark Plateaus in the north, Gulf Coastal Plain in the south, Ouachita Mountains in between, and Mississippi Delta to the east. Letters in the upper left of counties indicate county identifications as follows: A-Arkansas, B-Benton, C-Calhoun, D-Carroll, E-Clark, F-Cleveland, G-Crawford, H-Desha, I-Franklin, J-Grant, K-Hot Spring, L-Howard, M-Johnson, N-Logan, O-Madison, P-Monroe, Q-Montgomery, R-Newton, S-Phillips, T-Polk, U-Pope, V-Prairie, W-Stone, X-Union, Y-Van Buren, Z-Washington.

the state (James and Neal, 1986) and elsewhere (Hamel, 1992; Rosenberg et al., 1998): that they occur in mature upland and bottomland hardwood forests. The occupied upland sites were mainly in the Ozarks with a smaller number in the Ouachitas, usually above 1000 ft (305 m) elevation but primarily higher with nearly three-fourths of upland sites exceeding 1500 ft (457 m) to over 2000 ft (609 m). In the other regions warblers were found in low bottomland or riverine forests sites down to below 100 ft (30 m) in elevation.

Comparing the distribution of Cerulean Warblers in Arkansas in the 1990s (Fig. 2) with records from the Arkansas Audubon Society Bird Records File compiled from the 1940s through 1973 (Fig. 3) shows no striking changes in the county pattern of distribution although looking carefully at the two figures there is a noticeable presence of warbler occurrences in the eastern Ozarks and adjacent counties in the early years (Fig. 3) that appears shifted to the western Ozarks in later years (Fig 2). This pattern is mainly attributable to differences in coverage in the two periods and dominated by Ben Coffey and his colleagues in the eastern Ozarks active during the early years, replaced in the 1990s by activities spawned by the University of Arkansas at Fayetteville in the western counties. In the two periods com-

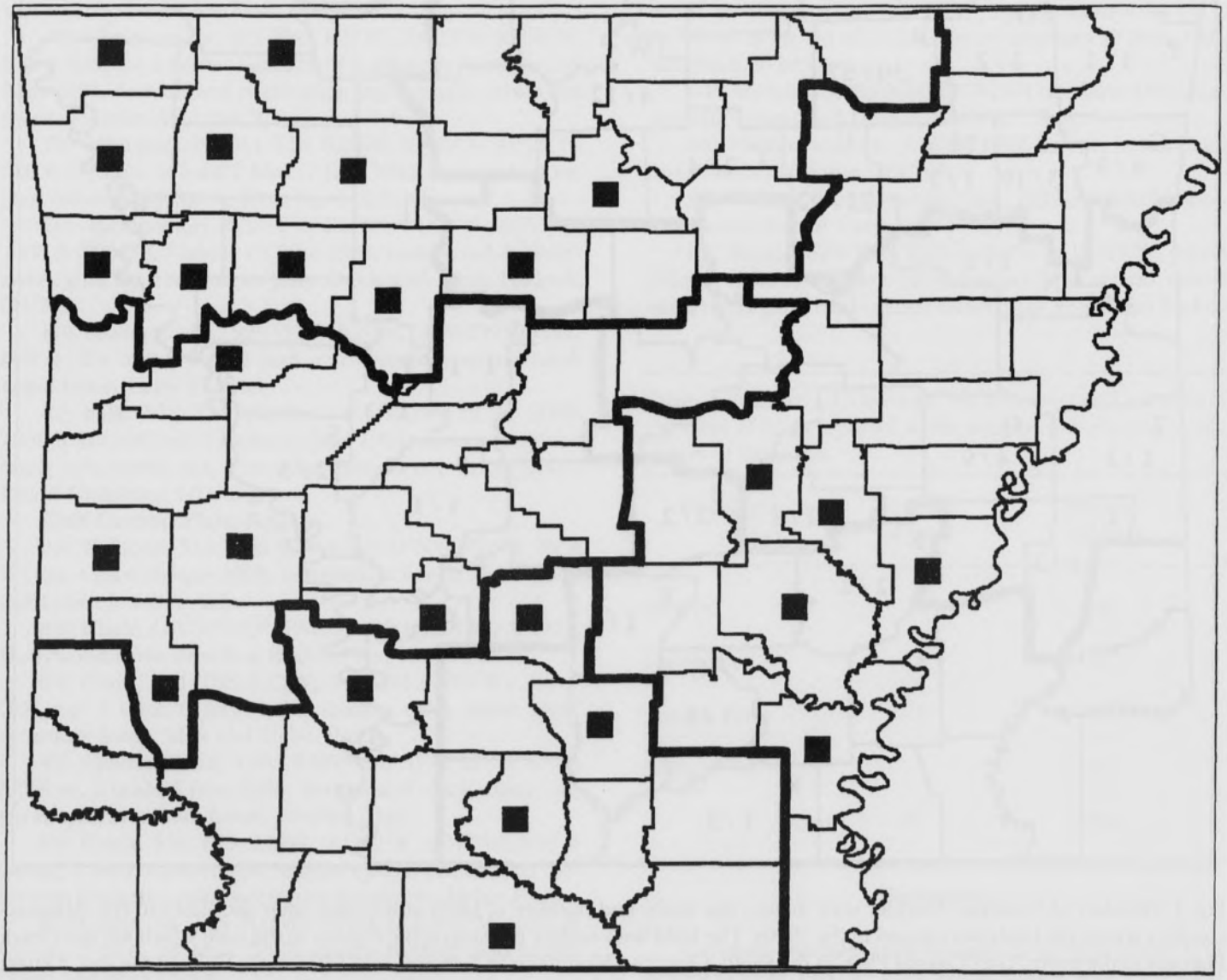

Fig. 2. Counties in Arkansas where Cerulean Warblers were found in the 1990s (squares). Bold lines outline the physiographic regions of Arkansas as described in Fig. 1.

ned there were a total of 38 counties of occurrence; the rbler was found during both periods in 16 counties, 10 unties in the 1990s only, and in 12 counties only through 73. This distribution did not deviate significantly from a nomial expansion (Chi-square=1.158, d.f.=2, $P>0.05$), dicating there was no pattern of change occurring between e two time periods. There were 28 counties with Cerulean arblers through 1973 and 26 counties in the 1990s. Due to e lack of any systematic surveys, it is not possible to assess liably any changes in distribution and abundance in the rds over time.

Jennifer Akin's survey of former and potential Cerulean Warbler areas in lowland forests of southern and eastern Arkansas covered 23 sites. She found birds at 3 places; all were locations where the species was found previously in the 1950s. None were found at the other localities that included two places where birds were found in the 1950s, but where now the habitat is greatly altered.

Mature forests occupied by Cerulean Warblers possess a degree of forest canopy irregularity, either with trees protruding above the others, or with small breaks in the canopy (Rosenberg et al., 1998; Paul B. Hamel, pers. comm.). It is

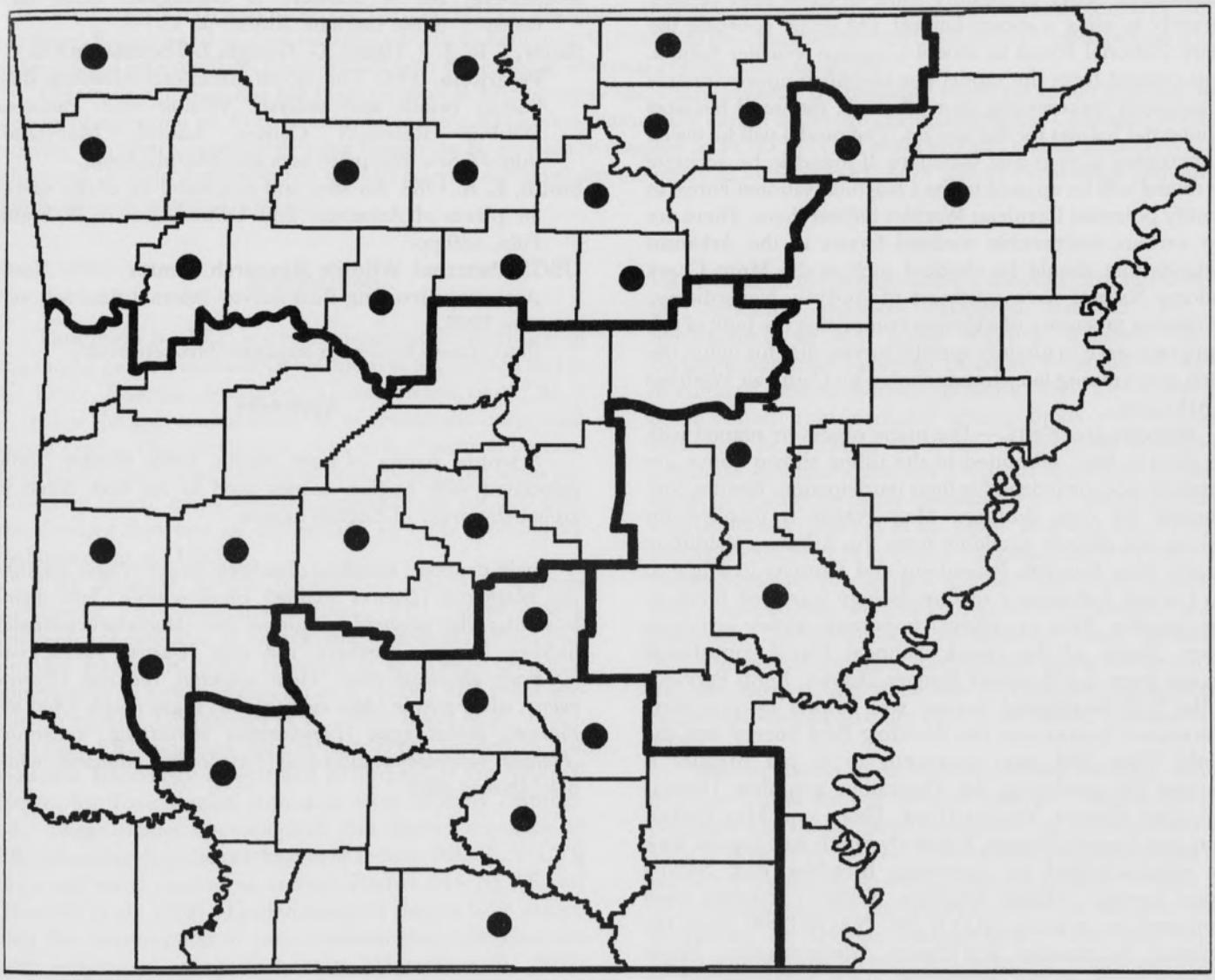

Fig. 3. Counties in Arkansas where Cerulean Warblers were found from the 1940's through 1973 (circles). Bold lines outline the physiographic regions of Arkansas described in Fig. 1.

therefore interesting that Mlodinow (item 43 listed above) visited a location in the Ozark National Forest from 1994 through 1998 and found a Cerulean Warbler only in 1998 after the site received group selection treatment. Group selection is a forest harvest method where a small number of mature trees are harvested leaving the main forest structure relatively unmodified, but it does create openings in the canopy. This possible beneficial effect of group selection treatment on Cerulean Warblers is being investigated by one of us (Kellner).

Unquestionably, there are undiscovered sites where Cerulean Warblers occur in Arkansas, especially in the Ouachitas where it is very difficult to reach many promising locations. In order to identify some of these sites Kellner currently is using a recent landsat TM scene covering the Ozark National Forest to model Cerulean Warbler habitat. In its current form the model has identified approximately 50 locations representing more than six thousand hectares of potential habitat for the species. The model will be tested in upcoming springs and summers. If found to be accurate the model will be applied to the Ouachita National Forest to identify potential Cerulean Warbler habitat there. There are also various inaccessible wetland forests in the Arkansas lowlands that should be checked such as the Moro Creek Bottoms Natural Area southeast of Fordyce. Nevertheless, the current inventory of sightings comprising the bulk of this paper can serve to identify specific survey sites for future use when determining later trends shown by Cerulean Warblers in Arkansas.

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Appendix

Scientific names of trees (Smith, 1988, Hunter, 1989) associated with English names used in the text, listed in alphabetic order of English names.

bald cypress (*Taxodium distichum*), beech (*Fagus grandifolia*), black oak (*Quercus velutina*), black willow (*Salix nigra*), box elder (*Acer negundo*), cucumber tree (*Magnolia acuminata*), hickory (*Carya*), northern red oak (*Quercus rubra*), oak (*Quercus*), shortleaf pine (*Pinus echinata*), red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), sugar maple (*Acer saccharum*), sweet gum (*Liquidambar styraciflua*), sycamore (*Platanus occidentalis*), tulip tree (*Liriodendron tulipifera*), white oak (*Quercus alba*).