BLACK-THROATED BLUE AND CAPE MAY WARBLERS KILLED IN CENTRAL FLORIDA

By Walter Kingsley Taylor

For more than a decade thousands of migrants have been handled at several banding stations, primarily in the eastern United States, and from nocturnal kills at tall, lighted structures, and airport ceilometers. These facilities provide large samples useful in studying various aspects of avian biology. This paper presents data on relative abundance of each sex and age group, timing of migration, weights, and the autumn migration routes of the Black-throated Blue Warbler (*Dendroica caerulescens*) and the Cape May Warbler (*D. tigrina*). Particular attention is directed to the autumn migration of these species in Florida.

MATERIALS AND METHODS

Most of the specimens were obtained at the recently-erected (July 1969) WDBO-WFTV TV tower near Bithlo, Orange County, Florida. The 1,500-foot facility is the tallest structure in Florida. Further details of the tower's supporting structures, its lighting system, and of the surrounding area are given by Taylor and Anderson (1973)[1]. In addition to the tower samples, data from 186 Black-throated Blue and 136 Cape May warblers killed during spring migration at the Vertical Assembly Building (VAB), Cape Kennedy, Brevard County, Florida are included.

Most of the specimens were collected during the night and in the early morning. Many individuals had brain hemorrhages or other damaged areas to the head; these conditions indicate that death resulted from the birds hitting solid objects.

Nondesiccated individuals, frozen for less than three months, were weighed to the nearest 0.1 g on an Ohaus triple beam balance. Sex was determined by dissection and age by skull ossification.

To make comparisons between regions, the percentage of Black-throated Blue and Cape May warblers among the total number of identified parulids killed or banded was used (Tables 1 and 2). The types of assumptions to which this index of relative abundance is subject have been discussed in detail by Nisbet (1970) in his study of migration in the Blackpoll Warbler (*Dendroica striata*).

RESULTS AND DISCUSSION

Autumn migration.—Few autumn disasters have been reported for 100 or more Black-throated Blue or Cape May warblers killed on a single night at tall, lighted structures and at airport ceilometers in the United States and Canada. Of 67,640 parulids reported killed during autumn migration at these man-made structures in Canada and in the United States, 1,653 (2.4%) were Black-throated Blue Warblers and 597 (0.9%) were Cape May Warblers (Table 1). Of

[1]On 8 June 1973 the WDBO-WFTV TV tower suddenly collapsed, apparently from being overloaded.

91,344 parulids banded during autumn migration in the United States, 3,010 (3.3%) were Black-throated Blue Warblers and 3,684 (4.0%) were Cape May Warblers (Table 2). The data in both tables indicate that a large number of Black-throated Blue and Cape May warblers pass through the Atlantic Coastal States in autumn migra-

TABLE 1. Occurrences of Black-throated Blue and Cape May warblers among warblers killed in nocturnal autumnal migration.[1]

State/Province	Total warblers	Black-throated Blue Warblers	Per cent	Cape May Warblers	Per cent
Plains					
Saskatchewan	1,072	0	0.0	0	0.0
Manitoba	589	0	0.0	3	0.5
North Dakota	154	0	0.0	0	0.0
Kansas	586	3	0.5	0	0.0
Missouri	874	1	0.1	0	0.0
Great Lakes					
Minnesota	496	0	0.0	0	0.0
Wisconsin	12,228	8	0.06	246	2.0
Illinois	878	0	0.0	0	0.0
Indiana	172	2	1.1	4	2.3
Michigan	647	5	0.7	15	2.3
New York (upstate)	427	28	6.5	6	1.4
Eastern Inland					
Kentucky	184	0	0.0	1	0.5
Tennessee	19,827	27	0.1	25	0.1
Atlantic Coast					
New Hampshire	74	1	1.3	0	0.0
New York	715	57	7.9	16	2.2
Maryland	1,311	69	5.2	29	1.4
Washington, D. C.	892	16	1.7	8	0.8
North Carolina	3,345	318	9.5	80	2.4
South Carolina	3,149	24	0.7	5	0.1
Georgia	3,098	80	2.5	16	0.5
Jacksonville, Fla.	58	13	22.0	0	0.0
Tallahassee, Fla.	9,089	20	0.2	4	0.04
Orlando, Fla.	7,775	981	13.0	139	1.5
Totals	67,640	1,653	2.4	597	0.9

[1]data compiled from published and unpublished studies that cover primarily these last 10 years (see Acknowledgments and Appendix).

tion. Bell (1971) postulated that both the Cape May and Black-throated Blue warblers, among four other parulid species, use the mountain flyway in greater numbers than the Atlantic coast as a regular avenue to their wintering grounds. On 5 October 1971 an unexpected large kill of 203 Black-throated Blue Warblers occurred at the WWAY TV tower near Boiling Springs Lakes, Brunswick County, in southeastern North Carolina (J. Carter, unpubl. report).

In recent years large numbers of both species have been killed during spring and autumn migrations at various localities in Brevard County, Florida (Case, et al., 1965; L. Ellis, pers. comm.). Cooke (1904) recognized that the Black-throated Blue Warblers migrated

during the autumn in large numbers along both coasts of southern Florida but believed that the species was rare in central Florida. More recently, Nisbet (1970) postulated, based upon percentage frequencies among kills of warblers in selected states, that the Cape

TABLE 2. Occurrences of Black-throated Blue and Cape May warblers among warblers banded while migrating in the autumn[1].

Banding location	Total warblers	Black-throated Blue Warblers	Per cent	Cape May Warblers	Per cent
Manomet, Mass. (1966-1969)	1,601	15	0.9	24	1.4
Binghamton, N. Y. (1970-1972)	580	5	0.9	78	13.0
Island Beach, N. J. (1956-1972)	68,802	2,205	3.2	2,693	3.9
Ship Bottom, N. J. (1969-1972)	648	38	5.8	22	3.4
Powdermill, Penn. (1959-1971; Leberman and Clench, 1972)	13,785	58	0.4	431	3.1
Allegheny Front Mountain, W. Va. (1970, 1972)	4,069	562	13.8	425	10.4
Kiptopeke Beach, Va. (1970; Bagg, 1971)	1,634	126	7.7	9	0.5
Dauphin Island, Ala. (1970; Bagg, 1971)	225	1	0.4	0	0.0
Totals	91,344	3,010	3.3	3,684	4.0

[1]data compiled from published and unpublished studies. Individuals who sent results from their banding stations are mentioned in the Acknowledgments.

May Warbler's autumn migration route is similar to the Blackpoll Warbler's transatlantic flight from New England to the Lesser Antilles and South America. However, of 7,775 parulids killed during four consecutive autumn migration periods at the WDBO-WFTV facility, only 10 Blackpoll Warblers have been found compared with 139 Cape May Warblers. These figures are not very suggestive that the Cape May Warbler's autumn migration route, especially in Florida, is similar to that of the Blackpoll. Nisbet's (1970) data for Florida were obtained from the study of nocturnal disasters at the WCTV tower north of Tallahassee (Stoddard and Norris, 1967). At that tower only four Cape May and two Blackpoll warblers were found during an 11-year period. These figures are much lower than the 139 Cape May and 10 Blackpoll warblers collected during four years covering the same autumn months at the central Florida facility. Not only are both of these species uncommon autumn migrants in the Tallahassee area, as indicated by field observations and the WCTV studies, but also they are uncommon

autumn migrants in northwestern Florida (Weston, 1965; Sprunt, 1954). Similar data exist for the Black-throated Blue Warbler: at the Tallahassee tower, Stoddard and Norris (1967) reported only 19 Black-throated Blue Warblers during September, October, and November, whereas at WDBO, 981 Black-throated Blue Warblers were found during four years covering the same autumn months at the central Florida facility.

In addition to the Cape May Warbler, Nisbet (1970) postulated that the Connecticut Warbler (*Oporornis agilis*), Mourning Warbler (*O. philadelphia*), Wilson's Warbler (*Wilsonia pusilla*), and Nashville Warbler (*Vermivora ruficapilla*) have a migration route similar to that of the Blackpoll Warbler. Each of these species was represented by four or less individuals at the WCTV tower. Since none of the four species have hit the WDBO-WFTV facility in autumn migration, Nisbet's (1970) ideas regarding the autumn migration routes of these four warblers are supported.

Of 151 autumn disasters totaling one or more birds at WDBO-WFTV, 59 contained Black-throated Blue Warblers and 25 contained Cape May Warblers. Extreme dates for freshly-killed Black-throated Blues for four autumns were 10 September and 19 November; Cape Mays were found from 11 September to 21 October.

Since 11 September 1969, 987 Black-throated Blue Warblers have been collected: 335 in 1969, 343 in 1970, 181 in 1971, and 128 in 1972. Of 981 specimens killed in the autumn, 403 were collected in September, 571 in October, and 7 in November. The remaining six were found between 17 March and 1 May. The peak of this species' autumn migration in central Florida evidently lies between the last week of September to about mid-October. Since September 1969, 86 species represented by 9,129 individuals have been killed during autumn migration at WDBO-WFTV; the Black-throated Blue ranks the second most abundant species. The disasters at the facility are among the largest documented for this species. The single largest kill of 228 Black-throated Blue Warblers occurred on 28-29 September 1970.

Autumn migration of the Cape May Warbler through central Florida occurs over a shorter period of time and apparently involves fewer birds compared with the autumn migration of the Black-throated Blue Warbler. Since 11 September 1969, 145 Cape Mays have been collected: 17 in 1969, 68 in 1970, 24 in 1971, and 36 in 1972. Of 139 individuals killed in the autumn, 101 were collected in September and 38 in October. The remaining six specimens were collected between 21 April and 1 May. The single largest kill took place on 28-29 September 1970 when 51 Cape May Warblers were found.

Age ratios.—Immature and adult Black-throated Blue and Cape May warblers evidently migrate together because individuals of both age groups fell from the sky at the same time during a given kill. For the Black-throated Blue Warbler all four age-sex classes apparently arrive together in central Florida. From the earliest kill totaling 14 individuals, 3 were adult males, 3 were immature males, 4 were adult females, and 4 were immature females. Data from 880

of 981 Black-throated Blue Warblers collected at WDBO-WFTV in autumn migration clearly indicate the predominance of adults over immatures (Table 3).

TABLE 3. Seasonal casualty totals for 880 Black-throated Blue Warblers collected at the WDBO-WFTV TV Tower, autumns 1969-1972.

Dates	Adult males	Immature males	Adult females	Immature females	Totals
1–15 September	4	5	8	8	25
16–30 September	66	98	53	83	300
1–15 October	95	28	91	34	248
16–31 October	83	62	87	68	300
1–15 November	1	2	1	1	5
16–30 November	1	1			2
Totals	250	196	240	194	880

Adults (85) outnumbered immatures in 129 Cape May Warblers aged. The data in Table 4 indicate that a differential pattern of migration occurs for the Cape May in central Florida. Adults predominate in the September samples whereas immatures predominate in the smaller October samples. The first immatures were found on 25 September.

In recent years, studies from banding operations and tower kills have shown that many migratory species in eastern North America have a higher percentage of adults migrating southward by an inland route than by a coastal one (Barry, 1971; Heintzelman, 1972). These records appear to exist for both the Black-throated Blue and Cape May warblers; however, more data from various banding and TV tower kill studies need to be analyzed and reported. Our tower site is inland and adults of both species clearly predominate. Coastal sites reporting a higher percentage of immatures than adults for the

TABLE 4. Seasonal casualty totals for 127 Cape May Warblers collected at the WDBO-WFTV TV Tower, autumns 1969-1972.

Dates	Adult males	Immature males	Adult females	Immature females	Totals
1–15 September	14	0	5	0	19
16–30 September	30	8	27	11	76
1–15 October	4	5	1	5	15
16–31 October	1	9	1	6	17
Totals	49	22	34	22	127

Black-throated Blue Warbler and/or Cape May Warbler include Island Beach, New Jersey (Murray, 1966) and Ship Bottom, New Jersey (R. Foy, pers. comm.). One exception to the above records has been found. At Binghamton, New York, an inland site, F. Marsi (pers. comm.) found 75 immature and three adult Cape May Warblers during three autumn periods of banding.

Sex ratios.—Of 893 Black-throated Blue Warblers collected at WDBO-WFTV in the autumn, 456 were males and 437 were females. Adult males outnumbered individuals of the other three age-sex groups. Of 186 specimens taken from 17 April to 14 May at the VAB facility, 117 were males and 69 were females.

In the 129 Cape May Warblers collected at WDBO-WFTV in autumn, 72 were males and 57 were females. Adult males outnumbered individuals of the other age-sex classes. Of 136 specimens taken between 17 April and 14 May at the VAB, 82 were males and 54 were females.

Weights.—Both species taken during autumn migration were rated fat to very fat. Weights of 330 Black-throated Blue and of 75 Cape May warblers are given in Tables 5 and 6. The mean weights for both species regardless of age or sex are heavier than those reported by Murray and Jehl (1964) at Island Beach, New Jersey. Mean

TABLE 5. Weights (in grams) of Black-throated Blue Warblers killed at WDBO-WFTV, September, October, and November 1969-1971.

Age and Sex	Number	Mean ± S. D.	Range
Adult males	93	11.9 ± 0.90	9.6–14.0
Immature males	79	12.1 ± 0.84	10.2–13.9
Adult females	94	11.2 ± 0.82	9.6–13.8
Immature females	64	11.2 ± 0.83	9.3–13.4

TABLE 6. Weights (in grams) of Cape May Warblers killed at WDBO-WFTV, September and October 1969-1971.

Age and Sex	Number	Mean ± S. D.	Range
Adult males	24	12.6 ± 1.01	10.2–15.2
Immature males	15	12.4 ± 0.93	10.5–14.1
Adult females	20	12.3 ± 1.12	10.0–14.2
Immature females	16	12.2 ± 1.05	10.0–13.5

weights of 17 male (9.0 g) and five female (9.2 g) Black-throated Blue Warblers killed at WDBO-WFTV and the VAB during spring migration are lower than those of individuals killed in the autumn. Similar data exist for 21 Cape May Warblers taken at the VAB

facility in the spring: 15 males (9.9 g), 6 females (9.4 g). An overwater flight from the wintering grounds probably accounts for the lighter mean weights in spring compared to those of autumn birds. In a study of Ovenbirds (*Seiurus aurocapillus*) killed in central Florida, Taylor (1972) found that spring migrants had lower mean weights than autumn migrants.

SUMMARY

The Atlantic Coastal States are traversed by large numbers of Black-throated Blue and Cape May warblers migrating in autumn. In Florida, based upon field observations and tower studies, both species are more common in peninsular Florida than in the panhandle region in both spring and autumn. Data obtained from 981 autumn migrating Black-throated Blue and 139 Cape May warblers collected at the WDBO-WFTV TV tower in central Florida are presented. These data are supplemented by studying 186 Black-throated Blue and 136 Cape May warblers killed in the spring at the Vertical Assembly Building at Cape Kennedy. For both species, adults outnumbered immatures, males outnumbered females, and spring birds had lower mean weights than autumn birds.

ACKNOWLEDGMENTS

Thanks are extended to the owners and operators of the WDBO-WFTV facility. Special appreciation is offered to Bruce Anderson, Bette Schardien, and other students at FTU who have helped collect and process the birds. Specimens from the Vertical Assembly Building were kindly donated to FTU by Lon Ellis. I thank Dr. George A. Hall (Allegheny Front Mountain), Dr. Mary H. Clench (Powdermill), Mrs. Frederick Marsi (Binghamton), Mrs. Roger W. Foy (Ship Bottom), Mrs. Katherine G. Price (Island Beach), and Mrs. Kathleen S. Anderson (Manomet) for supplying data from their banding stations. Unpublished data from tower kills were sent to me from H. W. Copland (Manitoba Museum of Man and Nature), Geoffrey Rytell (Omega Navigation Station), and J. H. Carter, III (University of North Carolina at Wilmington).

LITERATURE CITED

Bagg, A. M. 1971. The changing seasons. *Amer. Birds*, **25:** 16-23.

Barry, J. J. 1971. Differential fall migration. *EBBA News*, **34:** 55-66.

Bell, R. K. 1971. A bird bander's diary. *EBBA News*, **34:** 39-40.

Case, L. D., H. Cruickshank, A. E. Ellis, and W. F. White. 1965. Weather causes heavy bird mortality. *Fla. Nat.*, **38:** 29-30.

Cooke, W. W. 1904. Distribution and migration of North American warblers. *Biol. Surv. Bull.*, **18.**

Heintzelman, D. S. 1972. Age classes of birds migrating southward through central New Jersey—autumn 1970. *EBBA News*, **35:** 239-244.

Leberman, R. C., and M. H. Clench. 1972. Bird-banding at Powdermill, 1971 and ten years reviewed. *Powdermill Nature Reserve, Research Report* No. 30.

Murray, B. G., Jr. 1966. Migration of age and sex classes of passerines on the Atlantic Coast in autumn. *Auk*, **83:** 352-360.

Murray, B. G., Jr. and J. R. Jehl, Jr. 1964. Weights of autumn migrants from coastal New Jersey. *Bird-Banding*, **35:** 253-263.

NISBET, I. C. T. 1970. Autumn migration of the Blackpoll Warbler: evidence for long flight provided by regional survey. *Bird-Banding*, **41**: 207-240.

SPRUNT, A., JR. 1954. Florida bird life (with addendum 1963). New York, Coward-McCann.

STODDARD, H. L., SR., AND R. A. NORRIS. 1967. Bird casualties at a Leon County, Florida TV tower: an eleven-year study. *Bull. Tall Timbers Research Station*, no. 8: 1-104.

TAYLOR, W. K. 1972. Analysis of Ovenbirds killed in central Florida. *Bird-Banding*, **43**: 15-19.

TAYLOR, W. K., and B. H. ANDERSON. 1973. Nocturnal migrants killed at a central Florida TV tower; autumns 1969-1971. *Wilson Bull.*, **85**: 42-51.

WESTON, F. M. 1965. A survey of the birdlife of northwestern Florida. *Bull. Tall Timbers Research Station*, no 5: 1-147.

Department of Biological Sciences, Florida Technological University, Orlando, Florida 32816.

Received 9 March 1973, accepted 26 July 1973.

APPENDIX

References used in this paper but not mentioned in the Literature Cited are listed herein.

ABLE, K. P. 1963. Television tower mortality in the Niagara frontier during fall, 1962. *Kingbird*, **13**: 192-195.

ADAMS, D. A. 1962. Nocturnal migrant mortality in the Carolinas, September, 1962. *Chat*, **26**: 83-88.

BELCHER, M., A. BINNIE, AND B. BINNIE. 1966. The 1965 fall warbler migration at Regina. *Blue Jay*, **24**: 10-15.

BREWER, R., AND J. A. ELLIS. 1958. An analysis of migrating birds killed at a television tower in east-central Illinois, September 1955-May 1957. *Auk*, **75**: 400-414.

CALDWELL, L. D., AND N. L. CUTHBERT. 1963. Bird mortality at television towers near Cadillac, Michigan. *Jack-Pine Warbler*, **41**: 80-89.

CARTER, J. H., III. 1972. Avian mortality at two television towers in southeastern North Carolina (unpubl. report).

CHAMBERLAIN, B. R. 1954. Disaster in migration. *Chat*, **18**: 104-105.

EASTERLA, D., G. JACKSON, K. MARTINSON, AND D. SNYDER. 1961. Large bird kills at TV towers. *Bluebird*, **28**: 9.

ELDER, W. H., AND J. HANSEN. 1967. Bird mortality at KOMU-TV tower, Columbia, Missouri, Fall 1965 and 1966. *Bluebird*, **34**: 3-6.

GANIER, A. F. 1966. Some facts learned from nocturnal migration. *Migrant*, **37**: 27-34.

GOLLOP, M. A. 1965. Bird migration collision casualties at Saskatoon. *Blue Jay*, **23**: 15-17.

JOHNSTON, D. W. 1955. Mass bird mortality in Georgia, October, 1954. *Oriole*, **20**: 17-26.

JOHNSTON, D. W., AND T. P. HAINES. 1957. Analysis of mass bird mortality in October, 1954. *Auk*, **74**: 447-458.

KEMPER, C. A. 1958. Destruction at the TV tower. *Passenger Pigeon*, **20**: 3-9.

——. 1959. More TV tower destruction. *Passenger Pigeon*, **21**: 135-142.

KEMPER, C. A., S. D. ROBBINS, AND A. C. EPPLE. 1964. The ornithological flood of September 18-20, 1963. *Passenger Pigeon*, **26**: 159-172.

KEMPER, C. A., D. G. RAVELING, AND D. W. WARNER. 1966. A comparison of the species composition of two TV tower killed samples from the same night of migration. *Wilson Bull.*, **78**: 26-30.

LAHRMAN, F. W. 1962. Fall migration TV tower kills, 1962. *Blue Jay*, **20:** 152.

——— 1965. Regina and Lumsden TV tower bird mortalities, 1964. *Blue Jay*, **23:** 18-19.

LASKEY, A. R. 1966. T. V. tower casualties at Nashville; spring and fall, 1966. *Migrant*, **37:** 61-62.

——— 1968. Television tower casualties at Nashville, autumn 1967. *Migrant*, **39:** 25-26.

——— 1969. T. V. tower casualties at Nashville in autumn 1968. *Migrant*, **40:** 25-26.

——— 1969. Autumn 1969 T. V. tower casualties at Nashville. *Migrant*, **40:** 79-80.

LORD, W. G. 1951. Bird fatalities at Bluff's Lodge on the Blue Ridge Parkway, Wilkes County, N. C. *Chat*, **15:** 15-16.

LOVELL, H. B. 1952. Catastrophe to birds at a Louisville airport. *Kentucky Warbler*, **28:** 5-6.

MANUWAL, D. D. 1963. TV transmitter kills in South Bend Indiana, fall 1962. *Ind. Aud. Quart.*, **41:** 49-53.

MERITT, J. K. 1960. An Albany airport ceilometer disaster in 1956. *Kingbird*, **10:** 170-171.

NERO, R. W. 1961. Regina TV tower bird mortalities—1961. *Blue Jay*, **19:** 160-164.

NORTHERN PRAIRIE WILDLIFE RESEARCH CENTER. 1972. Investigations of bird migration and bird mortality at the Omega Navigation Station, Lamoure, North Dakota—1971 (unpubl. report).

——— 1972. Investigations of bird migration and losses associated with the Omega Navigation Station, Lamoure, North Dakota—fall 1972 (unpubl. report).

OVERING, R. 1936. The 1935 fall migration at the Washington Monument. *Wilson Bull.*, **48:** 222-224.

——— 1937. The 1936 fall migration at the Washington Monument. *Wilson Bulle.*, **49:** 118-119.

——— 1938. The 1937 fall migration at the Washington Monument. *Wilson Bull.*, **50:** 146.

PARMALEE, P. W., AND B. G. PARMALEE. 1959. Mortality of birds at a television tower in central Illinois. *Aud. Bull.*, no. 111, pp. 1-4.

PARMALEE, P. W., AND M. D. THOMPSON. 1963. A second kill of birds at a television tower in central Illinois. *Aud. Bull.*, no. 128, pp. 13-15.

POST, W., JR. 1963. Tower casualties at Aiken, South Carolina. *Chat*, **27:** 23.

SAWYER, P. J. 1961. Bird mortality at the WENH-TV tower in Deerfield, New Hampshire. *New Hampshire Audubon Quart.*, **14:** 46-49.

SHARP, B. 1971. Heavy mortality of migrating birds at Madison's TV towers. *Passenger Pigeon*, **33:** 203-204.

SMITH, L. B. 1966. Bird mortality at radio and TV towers near Winnipeg, September 1965. *Blue Jay*, **24:** 172-176.

SPOFFORD, W. R. 1949. Mortality of birds at the ceilometer of the Nashville airport. *Wilson Bull.*, **61:** 86-90.

STREET, T. E. 1954. The ceilometer hazard. *Chat*, **18:** 55-56.

TORDOFF, H. B., AND R. M. MENGEL. 1956. Studies of birds killed in nocturnal migration. *Univ. Kan. Publ. Mus. Nat. Hist.*, **10:** 1-44.