

BIRD-BANDING

A JOURNAL OF ORNITHOLOGICAL INVESTIGATION

VOL. XVII

OCTOBER 1946

No. 4

BLACK DUCK BANDINGS AT THE AUSTIN ORNITHOLOGICAL RESEARCH STATION (*continued*)

BY JOSEPH A. HAGAR

PART III

SOUTHWARD RECOVERIES OF CAPE COD BLACK DUCKS

Southward recoveries of Austin-banded Black Ducks, in marked contrast to the northward recoveries discussed in the preceding section, have been neither numerous nor regular.

Of all the Blacks recovered away from Cape Cod, only 12 per cent have come from south of Massachusetts. This in itself would indicate a very limited movement in that direction, but on closer examination its significance is still further reduced by the uneven distribution of the records in point of time. Three-fifths of them are concentrated in a single period of three years, which suggests the existence of some unusual and temporary cause. The remaining two-fifths are almost entirely long-term recoveries, which is contrary to the normal expectation. On the whole, it seems probable that recoveries south of the Cape do not represent a regular migration by a substantial part of the population, but either an erratic response to special circumstances, or straggling on the part of individual ducks.

This probability has been outlined in general terms by a previous investigator, but in the absence of supporting data has not been widely accepted as a part of conventional thinking on Black Duck distribution and migration in New England. There is good reason, then, to examine the evidence step by step in such detail as its nature permits.

DESCRIPTION OF DATA

Recoveries south of Massachusetts total 67, all in autumn and winter. Five of these were birds banded in August or September and recovered the same autumn; they may represent true southward migration or merely post-breeding-season dispersal, but since their direction coincides with normal migration they are included with the others.

When the records of these 67 ducks are put through an exploratory sorting, two facts emerge. The geographical pattern is relatively simple. The time pattern, on the contrary, is so diverse that its implications are not immediately apparent. Consequently, the first stage of orderly analysis is the arrangement and re-arrangement of the data so that each time-factor in turn is segregated from the others, and its trend determined. This process is carried out in the tables which follow.

Table VI classifies the whole sample according to place and term of recovery. Map II, using separate symbols for same-season recoveries and recoveries in all later years, gives a graphic representation of the same material. Together, they supply a picture of the geographical distribution of recoveries, and a preliminary breakdown of the elapsed-time factor.

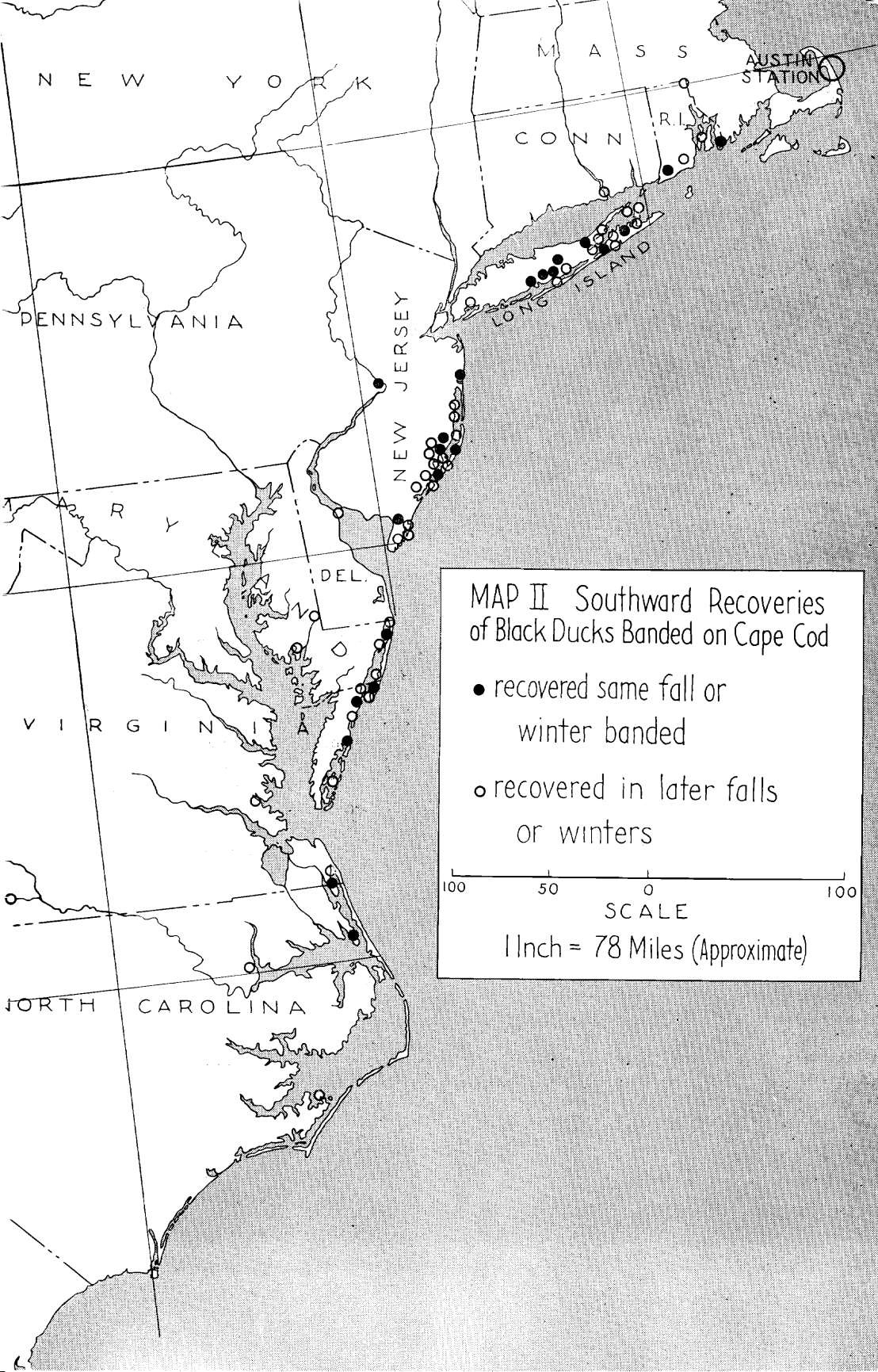
Looking first to geographical distribution, the bulk of the records are from the narrow band of salt-marsh directly along the coast, and moreover, show a definite grouping in eastern Long Island, southern New Jersey, and along the ocean side of the Maryland-Virginia Eastern Shore. It is probably significant, as shown by the right-hand column of the table, that these three groups of recoveries are so nearly equal in size instead of decreasing progressively from north to south; it well may mean that some of the birds have arrived at their destinations by the direct route over water.

Away from the coastal belt, there are scattering records on fresh or brackish water along the Delaware River, in Chesapeake Bay, and in northeastern North Carolina. The only aberrant record—a duck banded at the Station December 4, 1933, and reported killed on the Mississippi delta in "winter," 1934—is so extreme that it may well be due to a misread band, but this question is reserved for later discussion in con-

TABLE VI

SOUTHWARD RECOVERIES OF BLACK DUCKS BANDED BY AUSTIN STATION

Place of recovery	Recovered same fall banded	Recovered in later falls	Total recoveries	% of total recoveries
Rhode Island	2	3	5	} 36%
Connecticut	--	1	1	
Long Island, N. Y.	7	11	18	
New Jersey	6	14	20	} 33%
Pennsylvania	1	--	1	
Delaware	--	1	1	
Maryland	1	4	5	} 30%
Virginia	3	8	11	
North Carolina	2	2	4	
Louisiana	1	--	1	
Totals	23 (34%)	44 (66%)	67	



nection with two or three somewhat comparable records from other Massachusetts stations. By and large, the important inference to be drawn from Table VI and the map is that these 67 ducks have not gone far south, and have shown a very limited tendency to fan out to the westward.

The separation of the records into same-season recoveries and recoveries in all later autumns discloses the curious fact of an approximate 1:2 ratio between them. This ratio seems to be maintained within the whole range of dispersion down the coast, which is to say that it meets the test of geographical consistency, and the logical next step is a breakdown of its time-elements. Before this is done, however, a slight reduction of the sample is in order.

Of the 4,522 ducks originally banded in the mid-winter operations at Pleasant Bay and Nauset Inlet, only four were later recovered to the southward. One of these is of incidental interest as the only Austin-banded Black ever recovered from the state of Connecticut; it was trapped at Pleasant Bay on January 15, 1941, repeated five times to February 6, and was shot at Saybrook near the mouth of the Connecticut River during the third season afterward—October 20, 1943. The other three of the four were retaken in New Jersey, in tidewater Virginia, and again in New Jersey, during the first, second, and fourth Decembers after banding. Their distribution, then, is about the same as the distribution of the whole 67, but the rate at which they were recovered is so low as to distort the rate-of-recovery figures for the more normally distributed sample of 5,849 birds originally banded at the Austin Station proper and Great Pond, Eastham. These four birds are therefore dropped, and the remaining tables are based upon 63 recoveries.

Table VII classifies these 63 recoveries according to the seasons of the year when they were first banded, and then converts the totals into rates of recovery. The four seasons used have been previously defined in Table II, but without detailed justification; it seems appropriate at this point to introduce the evidence for setting November 30 as the close of fall migration, and February 1 as the beginning of spring migration.

Briefly, the records show that 93% of all same-season recoveries south of the Cape, including Bristol and Plymouth counties, Massachusetts, were banded before December 1. The exceptions are confined wholly to the autumn of 1933, when it can be shown that weather conditions were abnormal. There are indications that a good many ducks arrive on the Cape from maritime Nova Scotia during early December, but these birds supply very few southward recoveries in the same or later years. In the light of these facts, it is reasonable to conclude that the migratory urge is substantially spent by November 30.

The data for spring are less precise, but sufficient. In the first place, there is an extensive shifting and shuffling of the winter population of Blacks on the Cape immediately after the ice breaks up, followed by

some northward departure. The date varies from year to year, but is occasionally as early as February 1 and never later than the 20th. It is manifested not only by visible changes in numbers and distribution, but by successive little flurries of new and return ducks in the permanent traps. Among these are an increased percentage of birds which turn up to the south in later years, and may therefore be spring migrants on the Cape when first caught. Two such ducks were banded at the Station as early as the first week in February. Since the recognition of northward movement is relatively more important than anything else at that particular time of year, it again seems reasonable to designate February 1 as the approximate dividing line between the seasons.

Looking now to the import of Table VII, it first of all narrows down the source of those Blacks which are later recovered southward. Rates of recovery for birds banded autumn and spring are three to four times greater than for winter bandings. The rate of recovery for July-September bandings is only slightly less than for October-November. In practical terms, it is the so-called "local" ducks and the arrivals from the non-maritime parts of New Brunswick and Maine—the least important parts of the Cape stock numerically—which supply the bulk of southward recoveries.

Table VII also provides a more detailed separation of the records into same-season and later-season recoveries. It appears that even in the October-November group, banded when the migratory urge is strongest, there are more recoveries in later years than in the fall and winter of banding. This is the most revealing clue of all to the casual nature of southward migration from Cape Cod. A moment's reflection will show that any sustained and regular movement of Black Ducks across Cape Cod to points farther south could be expected to produce an excess of same-season recoveries. Distances are relatively short. The opportunity for recovery is provided by later seasons—shooting has never stopped in the middle Atlantic states before December 15, and in most

TABLE VII
SOUTHWARD RECOVERIES BY SEASONS ORIGINALLY BANDED

Banded	Recovered south same fall	Recovered south later falls	Total recov- eries	Total bandings in season	% of banded birds recovered
July to September	5	9	14	997	1.4
October November	15	17	32	1,876	1.7
December January	3	5	8	2,244	.4
February to May	—	9	9	732	1.2
Totals	23	40	63	5,849	

of the years since 1930 has extended to the last of December or the middle of January. Given this opportunity, same-season recoveries would be ordinarily more numerous simply because the banded sample is so much larger; later-season recoveries must come from the reduced group of birds which have survived the normal mortality of at least twelve months. Yet the records show that only in the single year 1933 did the October-November bandings produce an excess (9 to 4) of same-season recoveries to the south.

Table VIII supplies the final breakdown of the distribution of southward recoveries in point of time, and in doing so, gives perhaps the most truly proportioned picture of the whole situation that is possible. The low average rate of recovery—1.1% against the 4% rate for northward recoveries—indicates the relative unimportance of southward movement. Beyond that, the table shows 96% of same-season recoveries (black-face type), 61% of total recoveries (bottom line), and radically higher rates of recovery (right-hand column), all falling in the three-year period from 1932 to 1935. Finally, it shows through the remaining years only a thin sprinkling of records, all but one of which are long-term recoveries.

Clearly enough, the interpretation of southward recoveries rests upon the answers to two questions. Can we account for the high incidence of recoveries in 1932-35? Can we then draw any sound inference from the fact that the recoveries of other years consist almost entirely of ducks killed a year or more after they were banded?

SOUTHWARD RECOVERIES IN 1932-35

The entries in the upper left-hand corner of Table VIII, supplemented by such data as are to be found in the file-cards and daily records of the Station, reveal some interesting details of the southward movement of Blacks from Cape Cod in the autumns of 1932, 1933, and 1934.

To begin with 1931-32, the total bandings that year were 613 but the traps were not put in operation until November 21, and only 148 ducks had been caught at the end of the month. It is not surprising that there were no same-season recoveries, but the distribution of later-season recoveries—none in 1932, two in 1933—is worth noting in connection with what follows.

The fall of 1932 saw 594 ducks banded before December 1, and for the first time there were same-season recoveries. In order of recovery, they were as follows:—

BANDED IN 1932-33:

1. Sept. 17; 2 repeats to Sept. 26
2. Nov. 3
3. Oct. 20
4. Nov. 16
5. Oct. 2; 4 rpts. to Oct. 13
6. Nov. 15
7. Nov. 27

RECOVERED IN 1932-33:

- | | |
|------------------|----------------|
| Nov. 2 | Long Island |
| Nov. 8 (5 days) | Pennsylvania |
| Nov. 11 | New Jersey |
| Nov. 22 (6 days) | North Carolina |
| Dec. 4 | Long Island |
| Dec. 15 | New Jersey |
| Dec. 26 | New Jersey |

It thus appears that departure from the Cape was during the normal season of migration, and recoveries were complete in December although gunning from Maryland south lasted until January 15. Departure could not have been *en masse*, because some birds were killed down the coast before others were banded at the Cape. There was no particular grouping, but rather a haphazard distribution, of recoveries, and there were no recoveries from the bandings of 1931-32.

The next year, 1933-34, was the year when the Black Duck population of Cape Cod slumped sharply in the last half of December and remained low for several seasons (page 109). It was also the year which set all records for southward recoveries. Same-season recoveries were double the previous year, although new bandings to December were only 56% as great. Same-season recoveries exceeded later-season recoveries, although these too were at a high level—2 from the bandings of 1931-32, 8 from 1932-33. Finally, the rate-of-recovery index at 2.9 was higher than it ever climbed again.

The specific records, excluding three which are incomplete as to date of recovery, are as follows (same-season bandings in black-face type, recoveries classified by regions) :—

BANDED :	RECOVERED IN 1933-34:	
1. 1933—Mar. 16; 1 repeat Mar. 17	Oct. 16	Rhode Island
2. 1933 —Oct. 30	Nov. 2	Rhode Island
3. 1933 —Nov. 4	" 15	Long Island
4. 1933 —Nov. 3	" 16	Long Island
5. 1932—Nov. 25; 1 repeat Jan. 3	" 20	Rhode Island
6. 1932—Oct. 12; 1 repeat Oct. 14	" 28	Long Island
7. 1932—Apr. 14	Dec. 2	Long Island
8. 1932—Oct. 12	" 6	Long Island
9. 1932—Dec. 12; 1 repeat Feb. 18	" 15	Virginia
10. 1932—Dec. 15	" 15	Virginia
11. 1933 —Nov. 3	" 21	Long Island
12. 1931—Nov. 25	" 25	Virginia
13. 1933—Apr. 11; 3 rpts. to May 4	" 25	North Carolina
14. 1933 —Nov. 5; 5 rpts. to Nov. 24	" 29	New Jersey
15. 1933 —Dec. 18	Jan. —	New Jersey
16. 1932—Nov. 21	" 6	New Jersey
17. 1933 —Nov. 22	" 8	Rhode Island
18. 1933 —Nov. 7	" 8	North Carolina
19. 1933 —Nov. 7; 1 rpt. Nov. 11	" 13	Virginia
20. 1933 —Dec. 19	" 15	Maryland

From this tabulation it appears that most of the southward recoveries of 1933-34 fall into three well-defined groups, recognizable by differences in the season of banding and in place and time of recovery. Eight ducks, divided 3 to 5 between just-banded and banded in previous years, reached Rhode Island and Long Island before December 6. Four ducks, all banded in previous years, were taken in Virginia and North Carolina between December 15 and 25. Beginning four days later in New Jersey, five same-season ducks, two of them banded as recently as December 18-19, were recovered down the coast to North Carolina on

dates as late as January 15, the last day of the shooting season. This leaves three ducks—No. 11, which from the circumstance of having been with No. 4 in the trap at Cape Cod on November 3, probably belongs to the first group; and Nos. 16-17, which are not clearly a part of any group. Since inspection shows that these three records neither strengthen nor weaken the inferences to be drawn, they may be disregarded.

Obviously we have in group three the representatives of a substantial flight of Blacks leaving Cape Cod after the time when normal migration is over, and arriving rather far south at unusually late dates. The case is so clear-cut, indeed, that it immediately raises the question whether we can arrive at a definite estimate of the number of birds involved, for Table VIII indicates that this season of 1933-34 offers the best opportunity of judging the quantitative importance of southward migration. But when the facts are assembled, it appears unlikely that the number of banded departures was much over one hundred, and it may have been less.

The total bandings between November 21, 1931, and December 19, 1933, had been 2,450. Subtraction from this total of the known and calculated mortality indicates that probably no more than 1,050 remained alive on December 20, 1933. In spite of generally unfavorable conditions, 288 of these were actually in the Station traps at some time during the winter and spring of 1933-34. From the experience of later years it may be fairly estimated that the number of banded ducks wintering within a fifteen-mile radius of the Station is from 3 to 3½ times the number which actually return or repeat at the permanent traps after January 1. On this basis, from 870 to 1,000 of the surviving banded ducks probably wintered on Cape Cod, leaving a potential 180-50 for southward migration.

It may seem that the foregoing calculation leans rather heavily on estimates. It does, but it rests also on two solid facts:—288 previously banded Blacks can be accounted for on Cape Cod later than December 25; only five birds of the sample were turning up south of Long Island after the same date. This is a ratio of 58 to 1. Various exceptions may be taken to the basis of comparison, as that winter-banded birds should not be included, or that for one reason and another the chance of recovery is less once the ducks have left Cape Cod, but if the data are narrowed to meet any of these objections, the result is still essentially the same; *i.e.*, that whether banded in August or November, a great many more ducks can be explicitly placed on Cape Cod during any winter than can be even hypothetically accounted for farther south. And the very fact that the five ducks last mentioned above were recovered promptly enough on the middle Atlantic coast to be recognizable as a group is fairly good evidence that similar movements could be detected in the records if they had actually taken place.

Coming now to 1934-35, the last year of numerous southern recoveries, the records are these:—

BANDED:	RECOVERED IN 1934-35:	
1. 1934—Aug. 14	Oct. 18	New Jersey
2. 1933—Feb. 8	Nov. 15	Delaware
3. 1933—Dec. 21	" 17	Long Island
4. 1934—Apr. 6; 2 repeats to Apr. 12	" 17	Long Island
5. 1933—Sept. 12; 4 rpts. to Oct. 14	Dec. —	Long Island
6. 1934—Aug. 14	" 14	Virginia
7. 1933—Jan. 5; 3 rpts. to Apr. 10	" 20	Long Island
8. 1933—Sept. 10; 3 rpts. to Oct. 2	" 25	Long Island

Here are eight records which clearly represent the final stages of the movement of the two previous years. Later-season recoveries are again predominant by a 3 to 1 ratio. The only same-season recoveries, and incidentally two of the three farthest south, are birds banded in mid-August, almost certainly local-raised, and for that reason more likely to be cases of juvenile dispersion than of true migration. Of the other six, five went no farther south than Long Island. Dates of recovery are normal.

To sum up the history of these three seasons, the data indicate a moderate southward movement in October and November, 1932; a somewhat stronger movement during the same months of 1933, followed by a definite new wave of departures after the time when the migratory urge is normally spent; and in 1934, a tapering off to the level which proved to be typical for the remaining ten years of the study.

What, then, were the cause or causes of these southward recoveries from 1932 to 1935?

The daily records of the Austin Station contain no direct evidence with respect to unusual conditions at Cape Cod in the fall of 1932. This is not surprising, because the number of southward recoveries that year was not known until later, and even if known, could not have been recognized as unwonted in the absence of more extended experience with normal behavior. It is, however, a distinct limitation, for it means that the answer to 1932 can never be more than conjectural.

Accepting that fact, and beginning to think back over the years, no reader with a working knowledge of New England waterfowl ecology will be long in discovering the neat synchronism between this first season of southward recoveries and the disappearance of eelgrass. The further the thought is carried, the more do the important elements of correlation seem to be present. The destruction of eelgrass was under way on the Atlantic coast in 1931, but it was not everywhere apparent until the next year, so that 1932 was the first fall in which Blacks arriving on the Cape would have felt its full effect. A primary relationship between eelgrass and Black Ducks is a matter of record:—the seeds, the leaves, and occasionally even the rootstocks were found in substantial amounts in stomachs collected before 1930. Of much greater importance, the eel-

grass beds provided favorable environment for a whole series of shellfish and crustaceans which were, again by the evidence of stomachs, the basic and at times the indispensable food of the Blacks which wintered on the Massachusetts coast. When the eelgrass went, its invertebrate associates were affected, too; some of them were reduced to the point of disappearance, and even those which later adjusted themselves to the new conditions required a period of time to do so. In these circumstances, it might well be expected that the normal behavior pattern of the Black Duck population would show erratic modifications, including a tendency to migrate beyond the customary wintering-ground. And to complete the case, I may properly add that considerable searching has failed to turn up any other condition which might account so well for the movement of 1932.

By the fall of 1933 the unusual distribution and the growing scarcity of Black Ducks were apparently matters of comment at the Cape. The daily records reveal Station personnel increasingly alert to the situation, and searching for the explanation. They may or may not have found it at the time—there is no final statement—but reading the entries thirteen years later, one fact is quite clear. Whatever the original cause in 1932, it was almost surely compounded in 1933 by a series of early blizzards and cold spells most unusual in a region which frequently goes through the winter with no more than a few dustings of snow. Maurice Broun was banding ducks at the Station that winter; I cannot do better than to quote pertinent items from his notes:—

“November 16:—Cold wave. Meadow frozen hard, Dike Meadow completely frozen, . . . [birds] standing on ice all day.

“November 18:—Duck traps frozen in—meadow ice-bound—ducks and geese hugging the little pools [in the ice].

* * * *

“November 30:—More shooting on the Cape this fall than during past few seasons, yet the experienced gunners agree that there are fewer ducks.

* * * *

“December 9-10:—Northeast storm, [turning to] a blizzard at night. 6-10 inches of snow on ground, drifts 12-24 inches deep, minimum temperature 23°.

“December 12-13:—Strong west wind, temperature 8° at 6 A.M., maximum 18°. Thick ice-sheet at high-water line. . . . Temperature 10°-25° today. A broad white sheet of ice stretching far out into the Bay. Not a wild duck in sight, and the traps empty.

“December 14:—Snow during night and early morning; 6½ inches new fall on ground.

“December 16-17:—Mild. An 11-foot tide transformed the entire meadow into a sea of floating ice. . . . For the first time in three winters . . . a 100% trapful of unbanded ducks . . . it is possible that our local wintering ducks have taken themselves southward since the advent of bad weather. . . . The gunners tell Brewer ‘the ducks and geese aren’t staying—there’s very few on the flats because there’s nothing for them to eat.’

* * * *

“December 26-27:—Easterly blizzard—10 inches of snow, drifts to 2 feet.

“December 29-30:—Strong NW wind, temperature below zero all day. . . . Cape Cod Bay a vast plain of ice, with no [open] water as far as the eye can see.”

Such weather conditions as these are not the customary thing on Cape Cod in November and December. To my mind they adequately explain the equally unusual number of southward recoveries which accompanied and followed them. Actually, it turned out that more banded Blacks wintered on the Cape than seemed likely when some of these notes were written, because they reappeared in the Station traps as soon as the weather moderated, but this does not detract from the probability that severe icing, coming near the end of the migration period in a year when the ducks were already unsettled by a radical change in their environment, would quite naturally result in an abnormal southward movement.

Now finally, with respect to the fall of 1934, little further discussion is needed. I have already commented on the two same-season recoveries. Each of the six later-season recoveries might well have gone south in '33-'34 as part of the larger movement of that year, and merely returned there in '34-'35. Given the circumstances of 1932 and 1933, the recoveries of 1934 are their reasonable consequence, and the more so because they are largely confined to Long Island.

In summary, these years from 1932 to 1935 provide an interesting series of southern records, but whether they are analyzed by themselves, or laid against the experience of all the other years, or compared with the northward recoveries, their interest lies chiefly in their irregularities and diversities. They are not the parts of a single whole, but special cases. Because this is so, they cannot have major significance.

LATER-SEASON RECOVERIES

Of the 25 Austin ducks which were killed to the south in the ten years from 1935 to 1945, only one was a same-season recovery. It was banded at the Station August 12, 1937, repeated seven times to October 13, and was shot at the eastern end of Long Island in November. From the date of banding it was inferentially a bird of the year, and it did not go very far; it needs no further comment. The remaining 24 records were all made in seasons later than the one of banding, and for this reason if no other, merit a second glance.

Their distributional characteristics may be quickly summarized. Seven were banded at the Cape before September 30, twelve in October and November, one in winter, four in spring; the proportion between the seasons is very nearly the same as for all southward recoveries. Geographically, four records are from Rhode Island and Long Island, eleven from New Jersey, and nine from Maryland, Virginia, and North Carolina; the point of mean dispersion is somewhat farther south than for all recoveries. Table VIII shows that the maximum period of recovery is seven years, and the average period more than three years—a surprising figure in view of the short average longevity of the Black Duck. Finally, the bottom line of Table VIII suggests a cyclic tend-

ency, and when the percentages of recovery are compared with the annual population estimates (page 109), there is some evidence of correlation—the peak of each cycle accompanies or immediately follows a year of lowered population at the Cape. Furthermore, each peak is apparently the result of an increased recovery of younger or more recently banded birds—*i.e.*, the bandings of one or two years before.

Now obviously, these several trends would be interesting if only the records on which they rest were more numerous. Actually, the essential thing is that the records are so few. Not only is their real number small, but their potential importance is limited as well. Any attempt to expand their meaning presently comes up against the fact, already discussed, that very many more ducks of each annual sample can be found on Cape Cod during a given winter than can be found anywhere else. This effectively cuts off further speculation, and leaves the matter just here:—these records have accumulated too slowly to be of great consequence, and yet are too even and consistent to be entirely disregarded. What, then, lies behind them? Weighing their form, their distribution, and their volume, I find only one explanation which fits all the circumstances.

These records are apparently made by ducks which from time to time straggle to the westward of the particular flight-lane in which they were first banded, and are then caught up and carried along in the current of migration in some new lane rather than returning to Cape Cod. The idea cannot be fully developed until we consider the results of other banding operations in Massachusetts, but to anticipate for a moment, there is ample justification for the statement that all Black Duck migration in New England trends from northeast to southwest, and that the farther west a flight-lane lies, the farther south it extends. I have already shown, in discussing northward recoveries, that fall migration in the strictly maritime lane from Newfoundland to Cape Cod is later than along a more westerly route from Gaspé through New Brunswick. Neither does it reach so far south, because southward migration from the Cape is largely over by the time the maritime birds arrive from Nova Scotia. In fact, then, there are differences in the mode and rate of migration in different flight-lanes which will be recognizable as additional data are introduced.

That the bulk of any particular sample of ducks would tend to remain in an original flight-lane, while a minor fraction of them were straggling into other lanes, presents no difficulty; it is quite in line with other findings as to the behavior and migration of banded birds.

Some of the most suggestive evidence that later-season southward recoveries are birds which have entirely left the Cape Cod flight-lane in which they were originally banded, and become habituated to other routes, is to be found in the distribution of records in eastern Massachusetts. The coastal counties of the state, including the western half of Barnstable, have contributed 83 recoveries of Austin-banded ducks.

This is not a large number, all things considered, but the data are exceptionally interesting for the light they throw on specific paths of migration.

Map III plots the pattern, with a special symbol for birds banded at the Cape before August 31 and recovered on the mainland the same fall. The actual status of such birds when they are killed north of the banding station is so indeterminate that they may be largely disregarded. An introductory reading of the map will show that the ratio between same-season and later-season records is twice reversed, resulting in three distinct zones of recovery.

To begin at the top of the map, recoveries in the northeastern counties and as far down the coast as Plymouth are almost wholly later-season. The truth of this may be gauged by laying a pencil diagonally on the map with one end at Plymouth Harbor, the other below the two records in northeastern Worcester county. Since the axis of migration is northeast-southwest, the pencil will be found to lie at an approximate right angle across the line of flight. The actual count of recoveries to the northeast is 5 same-season to 29 later-season. Of the five same-season records, two were summer-banded birds, and the other three came from Duxbury Bay, at the extreme southeast corner. For practical purposes, the ratio is 0:29, with a slight overlapping of zones at Duxbury-Plymouth.

West and slightly south of west from the Austin Station, the recoveries are predominantly same-season. In Plymouth, Bristol, and the western half of Barnstable counties, the whole count is 26 same-season to 27 later-season. Discounting the overlapping at Plymouth, it is 26 to 13. More significant still, in the narrow sector bounded on the north by the Middleboro lakes and on the south by Falmouth, it is 13 to 4, or a ratio of $3\frac{1}{4}$:1.

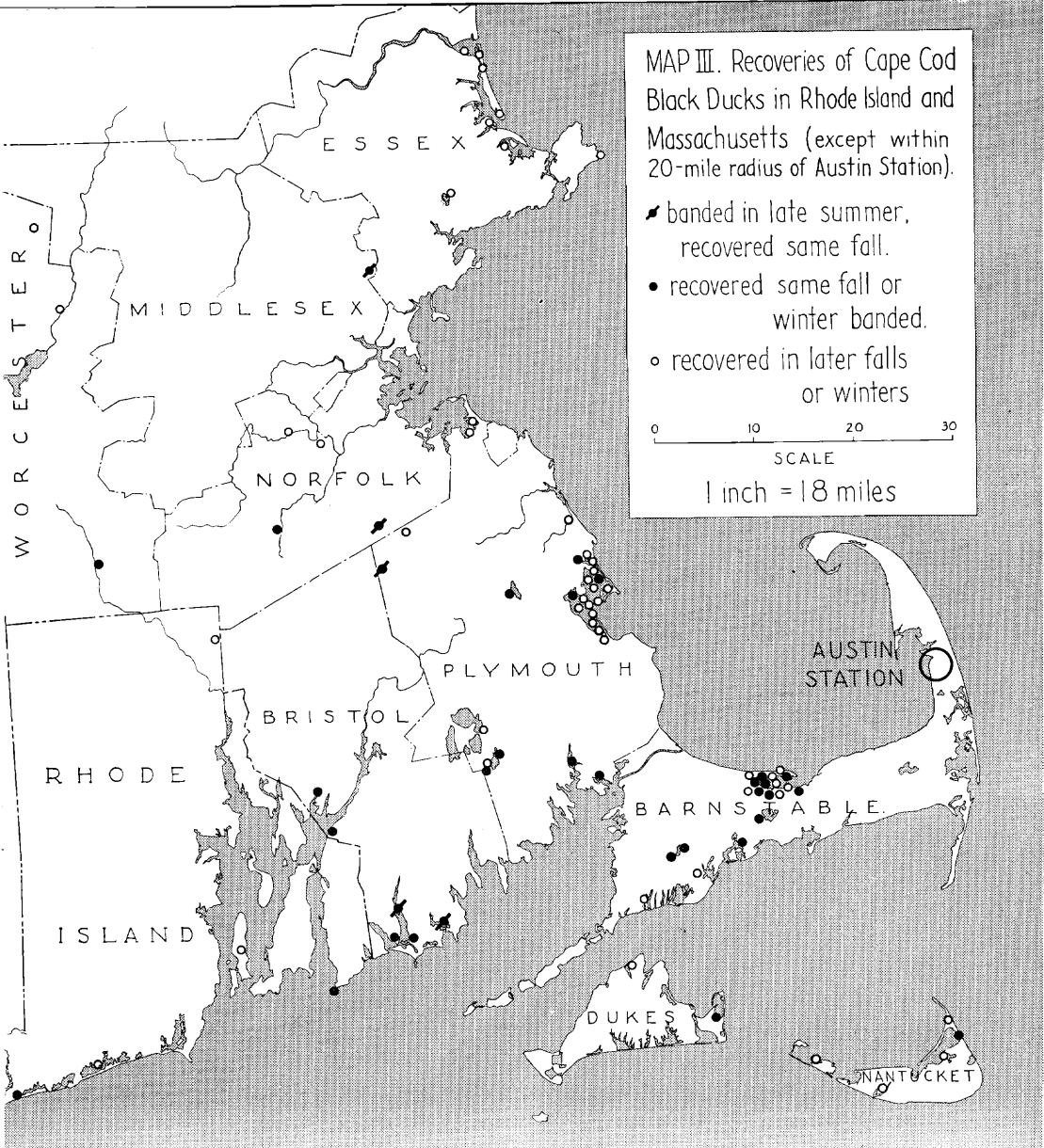
Now finally, there are Martha's Vineyard and Nantucket, lying within 30 miles of North Eastham, heavily gunned, and with a combined average winter population of 2,000-2,600 Blacks. Of the entire 10,371 ducks banded at the Austin Station, and I include the winter-banded birds at Pleasant Bay and Nauset for surely it would be expected that some of them would move south so short a distance as this, there have been just seven recoveries from the islands. One of these was a bona-fide same-season record at Haulover Bend 29 days after banding, one was a bird "found dead" at Chappaquiddick in February which might well have drifted across the Sound from the Cape, and the other five were killed one or two seasons after banding. The ratio is 1:2½.

The interpretation of these recoveries must always be more surmise than fact, more a groping for clues than hard and fast demonstration. Yet it seems to me there is a discernible order in their confusion.

Working back from south to north, it is clear enough that the link between the Black Duck populations of the islands and the Cape is slight indeed. This cuts both ways; it indicates that ducks banded at North

Eastham almost never leave the Cape in the direction of the islands, and that the wintering population at Nantucket, for instance, does not arrive across the Cape, but presumably direct from Nova Scotia. There is an implication that two points no farther apart than North Eastham and Nantucket are actually in parallel northeast-southwest flight-lanes so far as Black Ducks are concerned.

The usual route of southward departure from Cape Cod is marked out by the same-season recoveries in western Barnstable and southern



Plymouth and Bristol counties. What few newly banded birds from the Station continue down the coast, tend first to cross Cape Cod Bay to Duxbury, Kingston, Middleboro and Wareham, or go southwest through Barnstable and Falmouth. Undoubtedly some of the later-season recoveries in the same counties were doing the same thing. If not killed, they would have drifted southwest to the Westport-Little Compton shore, and thence crossed to Long Island.

Finally, the group of later-season recoveries at Plymouth and in the northeastern counties must be made up largely of birds which at the time of their death were not moving to or from Cape Cod at all, but were following a more westerly route. If they had not been killed in Massachusetts, some of them would have gone on cross-country to the southwest and been recovered on Long Island or in southern Jersey.

It is these birds which supply the clue to the great predominance of later-season recoveries on the middle Atlantic coast. They offer a credible explanation of the strange fact that older birds turn up farther south, two or three a year, without ever having been recorded at the Cape as returns, and unaccompanied by recently banded birds.

CONCLUSIONS

This completes the discussion of all Black Duck recoveries south and west of the Austin Station. The data are involved, and in many details, obscure. What broad inferences may be safely drawn from them for use in management?

The important fact about southward migration from Cape Cod seems to be its essential unimportance. Same-season recoveries, which would be of greatest significance if they occurred, are irregular and usually the result of special circumstances. Later-season recoveries are steady but few in number. Most records are strictly coastal, and not very far south. The migration urge is spent by December 1; ducks arriving from the northeast after that date are very rarely recovered farther south.

In terms of management, these findings are useful only as they limit and further define the problem. They dispose of the possibility that southward migration is a material consideration, and in doing so, strengthen the conclusion drawn from the preceding section that the numerical status of Cape Cod Black Ducks is determined by conditions on the Cape itself and to the northeast in Canada.

(To Be Continued)

Massachusetts Department of Conservation
15 Ashburton Place, Boston, Massachusetts.